IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

APPLERA CORPORATION, MDS INC., and APPLIED BIOSYSTEMS/MDS SCIEX INSTRUMENTS,	)	**REDACTED PUBLIC VERSION**
Plaintiffs,	)	
v.	)	C.A. No. 04-1230 GMS
THERMO ELECTRON CORP.,	)	
Defendant	)	
THERMO FINNIGAN LLC,	)	
Plaintiff,	)	
v.	)	C.A. No. 05-110-GMS
APPLERA CORPORATION, MDS INC., and APPLIED BIOSYSTEMS/MDS SCIEX INSTRUMENTS	)	
Defendants.	)	

APPENDIX TO THERMO'S ANSWERING MARKMAN BRIEF

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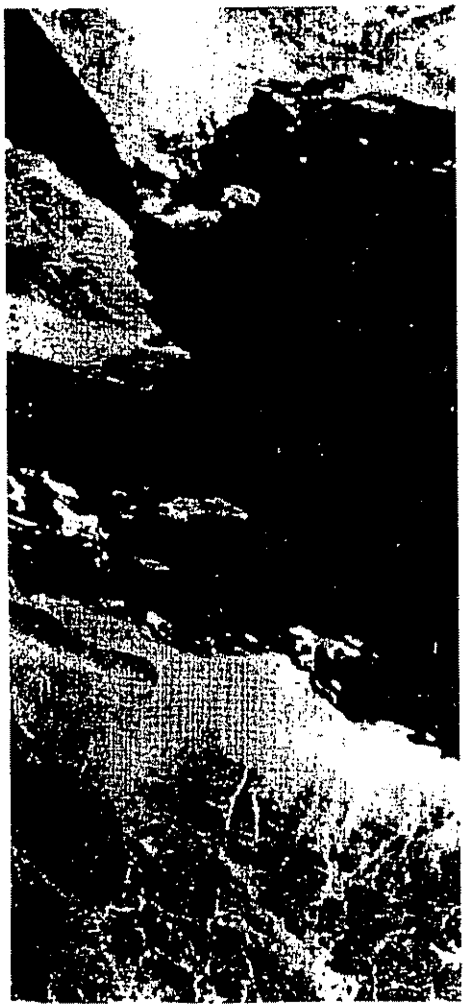
THERMO APPENDIX DOCUMENTS

EXHIBIT A

McGraw-Hill DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS

Fourth Edition



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Sybil P. Parker
EDITOR IN CHIEF

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On the cover: Pattern produced from white light by a computer-generated diffraction plate containing 529 square apertures arranged in a 23 × 23 array. (R. B. Hoover, Marshall Space Flight Center)

On the title pages: Aerial photograph of the Sinai Peninsula made by Gemini spacecraft. (NASA)

In addition, material has been drawn from the following references: R. E. Huschke, *Glossary of Meteorology*. American Meteorological Society. 1959; *U.S. Air Force Glossary of Standardized Terms*, AF Manual 11-1, vol. 1, 1972; *Communications-Electronics Terminology*, AF Manual 11-1, vol. 3, 1970; W. H. Allen, ed., *Dictionary of Technical Terms for Aerospace Use*, 1st ed., National Aeronautics and Space Administration, 1965; J. M. Gilliland, *Solar-Terrestrial Physics: A Glossary of Terms and Abbreviations*, Royal Aircraft Establishment Technical Report 67158, 1967; *Glossary of Air Traffic Control Terms*, Federal Aviation Agency; *A Glossary of Range Terminology*, *White Sands Missile Range, New Mexico*, National Bureau of Standards, AD 467-424; *A DOD Glossary of Mapping, Charting and Geodetic Terms*, 1st ed., Department of Defense, 1967; P. W. Thrush, comp. and ed., *A Dictionary of Mining, Mineral, and Related Terms*, Bureau of Mines, 1968; *Nuclear Terms: A Glossary*, 2d ed., Atomic Energy Commission; F. Casey, ed., *Compilation of Terms in Information* [redacted]ederal Council for Science and Technology, 1970; *Glossary of Stinfo Termi-* [redacted]pace Research, U.S. Air Force, 1963; *Naval Dictionary of Electronic, Tech-* [redacted] *Terms*, Bureau of Naval Personnel, 1962; *ADP Glossary*, Department of the [redacted]7.

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McGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, Fourth Edition

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TB 2

multiply connected region [MATH] An open set in the plane which has holes in it { 'məl·tə plē kə¦nek·təd 'rē jən }

multiply defined symbol [COMPUT SCI] Common assembler or compiler error printout indicating that a label has been used more than once { 'məl·tə·plē di¦fīnd 'sim·bəl }

multipoint line [COMMUN] A line which is shared by two or more different tributary stations { 'məl·tə,pȯint ,līn }

multipolar [ELECTROMAG] Having more than one pair of magnetic poles { ¦məl·tə'pō·lər }

multipolar machine [ELECTROMAG] An electric machine that has a field magnet with more than one pair of poles { ¦məl·tə'pō·lər mə'shēn }

multipole [ELECTROMAG] One of a series of types of static or oscillating distributions of charge or magnetization; namely, an electric multipole or a magnetic multipole { 'məl·tə,pōl }

multipole fields [ELECTROMAG] The electric and magnetic fields generated by static or oscillating electric or magnetic multipoles. { 'məl·tə,pōl ,fēlz }

multipole radiation [PHYS] **1.** Electromagnetic radiation which has characteristics equivalent to those of radiation generated by an oscillating electric or magnetic multipole, and is made up of photons of well-defined angular momentum and parity. **2.** Internal conversion electrons, or positron-electron pairs having similar characteristics, emitted from an atom when the nucleus makes a transition between two energy states { 'məl·tə,pōl ,rād·ē'ā·shən }

multipole transition [PHYS] A transition between two energy states of an atom or nucleus in which a quantum of multipole radiation is emitted or absorbed { 'məl·tə,pōl tran'zish·ən }

multiport burner [ENG] A burner having several nozzles which discharge fuel and air { 'məl·tə,pȯrt 'bər·nər }

multiport memory [COMPUT SCI] A memory shared by many processors to communicate among themselves { 'məl·tə,pȯrt 'mem·rē }

multiport network analyzer [ENG] A linear, passive microwave network having five or more ports which is used for measuring power and the complex reflection coefficient in a microwave circuit Also known as multiport reflectometer { 'məl·tə,pȯrt ¦net,wərk 'an·ə,līz·ər }

multiport reflectometer *See* multiport network analyzer { 'məl·tə,pȯrt ,rē,flek'täm·əd·ər }

multiprecision arithmetic [COMPUT SCI] A form of arithmetic similar to double precision arithmetic except that two or more words may be used to represent each number { ¦məl·tə·prə'sizh·ən ə'rith·mə,tik }

multiprocessing [COMPUT SCI] Carrying out of two or more sequences of instructions at the same time in a computer { ,məl·tə'prä,ses·iŋ }

multiprocessing system *See* multiprocessor { ,məl·tə'prä,ses·iŋ ,sis·təm }

multiprocessor [COMPUT SCI] A data-processing system that can carry out more than one program, or more than one arithmetic operation, at the same time. Also known as multiprocessing system { ,məl·tə'prä,ses·ər }

multiprocessor interleaving [COMPUT SCI] Technique used to speed up processing time; by splitting banks of memory each with x microseconds access time and accessing each one in sequence $1/n$-th of a cycle later, a reference to memory can be had every x/n microseconds; this speed is achieved at the cost of hardware complexity { ,məl·tə'prä,ses·ər ,in·tər'lēv·iŋ }

multiprogramming [COMPUT SCI] The interleaved execution of two or more programs by a computer, in which the central processing unit executes a few instructions from each program in succession { ,məl·tə'prō,gram·iŋ }

multiprogramming executive control [COMPUT SCI] Control program structure required to handle multiprogramming with either a fixed or a variable number of tasks { ,məl·tə'prō,gram·iŋ ig¦zek·yəd·iv kən'trōl }

multipropellant [AERO ENG] A rocket propellant consisting of two or more substances that are fed separately to the combustion chamber { ¦məl·tə prə'pel·ənt }

multipurpose projectile [ORD] A projectile designed so that the type of payload can be changed; this is accomplished by using prepared loads in canister form and providing a removable base plug to permit change of canister; thus a canister containing colored smoke mixture can be replaced by, for instance, one containing leaflets { ¦məl·tə'pər·pəs prə'jek·təl }

multiread feeding [COMPUT SCI] A system of reading punched cards in which the card passes a sensing station several times and successive fields of the card are read on consecutive machine cycles, enabling several lines to be printed from a single card Also known as multicycle feeding { 'məl tē,rēd ,fēd·iŋ }

multiring structure [ASTRON] A formation on the moon's surface consisting of two or more craters within a larger crater { 'məl·tə,riŋ ,strək·chər }

multirole programmable device [CONT SYS] A device that contains a programmable memory to store data on positioning robots and sequencing their motion { 'məl·tə,rōl prō¦gram·ə·bəl di'vīs }

multirope friction winder [MECH ENG] A winding system in which the drive to the winding ropes is the frictional resistance between the ropes and the driving sheaves { 'məl·tə,rōp 'frik·shən ,wīn·dər }

multisegment magnetron [ELECTR] Magnetron with an anode divided into more than two segments, usually by slots parallel to its axis { 'məl·tə,seg·mənt 'mag·nə,trän }

multispeed motor [ELEC] An induction motor that can rotate at any one of two or more speeds, independent of the load { 'məl·tə,spēd 'mōd·ər }

multistable circuit [ELECTR] A circuit having two or more stable operating conditions { 'məl·tə,stā·bəl 'sər·kət }

multistage [ENG] Functioning or occurring in separate steps { 'məl tē,stāj }

multistage amplifier *See* cascade amplifier { 'məl·tē,stāj 'am·plə,fī·ər }

multistage compressor [MECH ENG] A machine for compressing a gaseous fluid in a sequence of stages, with or without intercooling between stages { 'məl·tē,stāj kəm'pres·ər }

multistage pump [MECH ENG] A pump in which the head is developed by multiple impellers operating in series { 'məl·tē,stāj 'pəmp }

multistage queuing [IND ENG] A situation involving two or more sequential stages in a process, each of which involves waiting in line { 'məl·tē,stāj 'kyü·iŋ }

multistage rocket [AERO ENG] A vehicle having two or more rocket units, each unit firing after the one in back of it has exhausted its propellant; normally, each unit, or stage, is jettisoned after completing its firing Also known as multiple-stage rocket; step rocket. { 'məl·tē,stāj 'räk·ət }

multistatic radar [ENG] Radar in which successive antenna lobes are sequentially engaged to provide a tracking capability without physical movement of the antenna { 'məl·tē,stad·ik 'rā,där }

multistation [COMMUN] Pertaining to a network in which each station can communicate with each of the other stations { 'məl·tē,stā·shən }

multistator watt-hour meter [ELEC] An induction type of watt-hour meter in which several stators exert a torque on the rotor { 'məl·tē,stād·ər 'wat ,aùr ,mēd·ər }

multistrip coupler [ELECTR] A series of parallel metallic strips placed on a surface acoustic wave filter between identical apodized interdigital transducers; it converts the spatially nonuniform surface acoustic wave generated by one transducer into a spatially uniform wave received at the other transducer, and helps to reject spurious bulk acoustic modes { 'məl·tə,strip 'kəp·lər }

multisystem coupling [COMPUT SCI] The electronic connection of two or more computers in proximity to make them act as a single logical machine { 'məl·tə,sis·təm 'kəp·liŋ }

multisystem network [COMPUT SCI] A data communications network that has two or more host computers with which the various terminals in the system can communicate { 'məl·tə,sis·təm 'net,wərk }

multitape Turing machine [COMPUT SCI] A variation of a Turing machine in which more than one tape is permitted, each tape having its own read-write head { 'məl·tē,tāp 'tùr·iŋ mə,shēn }

multitask operation [COMPUT SCI] A sophisticated form of multijob operation in a computer which allows a single copy of a program module to be used for more than one task { ¦məl·tē'task ,äp·ə'rā·shən }

multithreading [COMPUT SCI] A processing technique that allows two or more of the same type of transaction to be carried out simultaneously { ¦məl·tə'thred·iŋ }

multitrack operation [COMPUT SCI] The selection of the next read/write head in a cylinder, usually indicated by bit zero of

EXHIBIT B

Ninth New Collegiate Dictionary

A Merriam-Webster®

MERRIAM-WEBSTER INC., *Publishers*
Springfield, Massachusetts, U.S.A.

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TB 5

po·lar·on \'pō-lə-,rän\ *n* [ISV *polar* + [2]*-on*] (1946) : a conducting electron in an ionic crystal together with the induced polarization of the surrounding lattice

pol·der \'pōl-dər, 'päl-\ *n* [D] (1604) : a tract of low land reclaimed from a body of water (as the sea)

[1]**pole** \'pōl\ *n* [ME, fr. OE *pāl* stake, pole, fr. L *palus* stake; akin to L *pangere* to fix — more at PACT] (bef. 12c) **1 a :** a long slender usu. cylindrical object (as a length of wood) **b :** a shaft which extends from the front axle of a wagon between wheelhorses and by which the wagon is drawn : TONGUE **c :** a long staff of wood, metal, or fiberglass used in the pole vault **2 a :** a varying unit of length; *esp* : one measuring 16½ feet (5.03 meters) **b :** a unit of area equal to a square rod (25.293 square meters) **3 :** a tree with a breast-high diameter of from 4 to 12 inches (10 to 30 centimeters) **4 :** the inside front row position on the starting line for a race

[2]**pole** *vb* **poled; pol·ing** *vt* (ca. 1753) **1 :** to act upon with a pole **2 :** to impel or push with a pole ~ *vi* **1 :** to propel a boat with a pole **2 :** to use ski poles to gain speed

[3]**pole** *n* [ME *pool*, fr. L *polus*, fr. Gk *polos* pivot, pole; akin to Gk *kyklos* wheel — more at WHEEL] (14c) **1 :** either extremity of an axis of a sphere and esp. of the earth's axis **2 a :** either of two related opposites **b :** a point of guidance or attraction **3 a :** one of the two terminals of an electric cell, battery, or dynamo **b :** one of two or more regions in a magnetized body at which the magnetic flux density is concentrated **4 :** either of two morphologically or physiologically differentiated areas at opposite ends of an axis in an organism or cell — see BLASTULA illustration **5 a :** the fixed point in a system of polar coordinates that serves as the origin **b :** the point of origin of two tangents to a conic section that determine a polar — **poles apart :** as diametrically opposed as possible ⟨the two voters were *poles apart* on that issue⟩

Pole \'pōl\ *n* [G, of Slavic origin; akin to Pol *Polak* Pole] (1589) **1 :** a native or inhabitant of Poland **2 :** a person of Polish descent

[1]**pole·ax** \'pō-,laks\ *n* [ME *polax*, *pollax*, fr. *pol*, *polle* poll + *ax*] (14c) **1 :** a battle-ax with short handle and often a hook or spike opposite the blade; *also* : one with a long handle used as an ornamental weapon **2 :** an ax used in slaughtering cattle

[2]**poleax** *vt* (1882) **:** to attack, strike, or fell with or as if with a poleax

pole bean *n* (1770) : a cultivated bean that is usu. trained to grow upright on supports

pole·cat \'pōl-,kat\ *n, pl* **polecats** *or* **polecat** [ME *polcat*, prob. fr. MF *poul*, *pol* cock + ME *cat*; prob. fr. its preying on poultry — more at PULLET] (14c) **1 :** a European carnivorous mammal (*Mustela putorius*) of which the ferret is considered a domesticated variety **2 :** SKUNK

pole horse *n* (1823) **1 :** a horse harnessed beside the pole of a wagon **2 :** the horse having a starting position next to the inside rail in a harness race

poleis *pl of* POLIS

pole·less \'pōl-ləs\ *adj* (1647) **:** having no pole

po·lem·ic \pə-'lem-ik\ *n* [F *polémique*, fr. MF, fr. *polemique* controversial, fr. Gk *polemikos* warlike, hostile, fr. *polemos* war; akin to OE *ealfelo* baleful, Gk *pallein* to brandish] (1638) **1 a :** an aggressive attack on or refutation of the opinions or principles of another **b :** the art or practice of disputation or controversy — usu. used in pl. but sing. or pl. in constr. **2 :** an aggressive controversialist : DISPUTANT — **po·lem·i·cist** \-'lem-ə-səst\ *n*

po·lem·i·cal \-i-kəl\ *also* **po·lem·ic** \-ik\ *adj* (1640) **1 :** of, relating to, or being a polemic : CONTROVERSIAL **2 :** engaged in or addicted to polemics : DISPUTATIOUS — **po·lem·i·cal·ly** \-i-k(ə-)lē\ *adv*

po·lem·i·cize \-'lem-ə-,sīz\ *vi* **-cized; -ciz·ing** (1950) : to engage in controversy : deliver a polemic

po·le·mist \pə-'lem-əst, 'päl-ə-məst\ *n* [irreg. fr. *polemic*] (1825) : one skilled in or given to polemics

pol·e·mize \'päl-ə-,mīz\ *vi* **-mized; -miz·ing** (1828) : POLEMICIZE

pol·e·mo·ni·um \,päl-ə-'mō-nē-əm\ *n* [NL, fr. Gk *polemōnion*, a plant] (1900) : JACOB'S LADDER

po·len·ta \pō-'lent-ə, pə-, -'len-,tä\ *n* [It, fr. L, pearl barley — more at POLLEN] (1598) : mush made of chestnut meal, cornmeal, semolina, or farina

pol·er \'pō-lər\ *n* (ca. 1864) : one that poles; *esp* : one that poles a boat

pole·star \'pōl-,stär\ *n* (1555) **1 :** NORTH STAR **2 a :** a directing principle : GUIDE **b :** a center of attraction

pole vault *n* (ca. 1890) : a vault with the aid of a pole; *specif* : a field event consisting of a vault for height over a crossbar — **pole–vault** *vi* — **pole–vault·er** *n*

pole·ward \'pōl-wərd\ *adv or adj* (1875) **:** toward or in the direction of a pole of the earth ⟨as the sun moves ~⟩ ⟨~ variation in temperature⟩

[1]**po·lice** \pə-'lēs\ *vt* **po·liced; po·lic·ing** (1589) **1** *archaic* : GOVERN **2 :** to control, regulate, or keep in order by use of police **3 :** to make clean and put in order **4 a :** to supervise the operation, execution, or administration of to prevent or detect and prosecute violations of rules and regulations **b :** to exercise such supervision over the policies and activities of **5 :** to perform the functions of a police force in or over

[2]**police** *n, pl* **police** *often attrib* [F, fr. LL *politia*, government, administration, fr. Gk *politeia*, fr. *politeuein* to be a citizen, engage in political activity, fr. *politēs* citizen, fr. *polis* city, state; akin to Skt *pur* city] (1716) **1 a :** the internal organization or regulation of a political unit through exercise of governmental powers esp. with respect to general comfort, health, morals, safety, or prosperity **b :** control and regulation of affairs affecting the general order and welfare of any unit or area **c :** the system of laws for effecting such control **2 a :** the department of government concerned primarily with maintenance of public order, safety, and health and enforcement of laws and possessing executive, judicial, and legislative powers **b :** the department of government charged with prevention, detection, and prosecution of public nuisances and crimes **3 a :** POLICE FORCE **b** *pl* : POLICEMEN **4 a :** a private organization resembling a police force ⟨campus ~⟩ **b** *pl* : the members of a private police organization **5 a :** the action or process of cleaning and putting in order **b :** military personnel detailed to perform this function

police action *n* (1933) : a localized military action undertaken without formal declaration of war by regular forces against persons held to be violators of international peace and order

police court *n* (1823) : a court of record that has jurisdiction over various minor offenses (as breach of the peace) and the power to bind over for trial in a superior court or for a grand jury persons accused of more serious offenses

police dog *n* (1908) **1 :** a dog trained to assist police (as in drug detection) **2 :** GERMAN SHEPHERD

police force *n* (1838) : a body of trained officers entrusted by a government with maintenance of public peace and order, enforcement of laws, and prevention and detection of crime

po·lice·man \pə-'lē-smən\ *n* (1801) **1 :** a member of a police force **2 :** one held to resemble a policeman ⟨making the United States the ~ for the whole wide world — R.B. Long⟩

police officer *n* (1800) : a member of a police force

police power *n* (1827) : the inherent power of a government to exercise reasonable control over persons and property within its jurisdiction in the interest of the general security, health, safety, morals, and welfare except where legally prohibited

police reporter *n* (1834) : a reporter regularly assigned to cover police news (as crimes and arrests)

police state *n* (1865) : a political unit characterized by repressive governmental control of political, economic, and social life usu. by an arbitrary exercise of power by police and esp. secret police in place of regular operation of administrative and judicial organs of the government according to publicly known legal procedures

police station *n* (1846) : the headquarters of the police for a particular locality

po·lice·wom·an \pə-'lē-,swu̇m-ən\ *n* (1853) : a woman who is a member of a police force

[1]**pol·i·cy** \'päl-ə-sē\ *n, pl* **-cies** *often attrib* [ME *policie*, government, policy, fr. MF, government, regulation, fr. LL *politia* — more at POLICE] (15c) **1 a :** prudence or wisdom in the management of affairs : SAGACITY **b :** management or procedure based primarily on material interest **2 a :** a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions **b :** a high-level overall plan embracing the general goals and acceptable procedures esp. of a governmental body

[2]**policy** *n, pl* **-cies** [alter. of earlier *police*, fr. MF, certificate, fr. OIt *polizza*, modif. of ML *apodixa* receipt, fr. MGk *apodeixis*, fr. Gk, proof, fr. *apodeiknynai* to demonstrate — more at APODICTIC] (1565) **1 :** a writing whereby a contract of insurance is made **2 a :** a daily lottery in which participants bet that certain numbers will be drawn from a lottery wheel **b :** NUMBER 7a

pol·i·cy·hold·er \'päl-ə-sē-,hōl-dər\ *n* (1851) : the owner of an insurance policy

pol·i·cy–mak·ing \-,mā-kiŋ\ *n* (1942) : the high-level elaboration of policy and esp. of governmental policy — **pol·i·cy·mak·er** \-kər\ *n*

policy science *n* (1950) : a social science dealing with the making of high-level policy (as in a government or business)

po·lio \'pō-lē-,ō\ *n* (1931) : POLIOMYELITIS

po·lio·my·eli·tis \,pō-lē-(,)ō-,mī-ə-'līt-əs\ *n* [NL, fr. Gk *polios* gray + *myelos* marrow — more at FALLOW, MYEL-] (1878) : an acute infectious virus disease characterized by fever, motor paralysis, and atrophy of skeletal muscles often with permanent disability and deformity and marked by inflammation of nerve cells in the anterior horns of the spinal cord — called also *infantile paralysis*

po·lio·vi·rus \'pō-lē-(,)ō-,vī-rəs\ *n* [NL, fr. *polio*myelitis + *virus*] (1953) : an enterovirus that occurs in several antigenically distinct forms and is the causative agent of human poliomyelitis

po·lis \'päl-əs\ *n, pl* **po·leis** \'päl-,ās\ [Gk — more at POLICE] (1894) : a Greek city-state; *broadly* : a state or society esp. when characterized by a sense of community

-p·o·lis \p-(ə-)ləs\ *n comb form* [LL, fr. Gk, fr. *polis*] : city ⟨megalo*polis*⟩

[1]**pol·ish** \'päl-ish\ *vb* [ME *polisshen*, fr. MF *poliss-*, stem of *polir*, fr. L *polire*] *vt* (14c) **1 :** to make smooth and glossy usu. by friction : BURNISH **2 :** to smooth, soften, or refine in manners or condition **3 :** to bring to a highly developed, finished, or refined state : PERFECT ~ *vi* **:** to become smooth or glossy by or as if by friction — **pol·ish·er** *n*

[2]**polish** *n* (1704) **1 a :** a smooth glossy surface : LUSTER **b :** freedom from rudeness or coarseness : CULTURE **c :** a state of high development or refinement **2 :** the action or process of polishing **3 :** a preparation that is used to produce a gloss and often a color for the protection and decoration of a surface ⟨furniture ~⟩ ⟨nail ~⟩

[1]**Pol·ish** \'pō-lish\ *adj* [*Pole*] (1674) : of, relating to, or characteristic of Poland, the Poles, or Polish

[2]**Polish** *n* (1784) : the Slavic language of the Poles

polish off *vt* (1829) : to finish off or dispose of rapidly or completely

po·lit·bu·ro \'päl-ət-,byu̇(ə)r-(,)ō, 'pō-lət-, pə-'lit-\ *n* [Russ *politbyuro*, fr. *politicheskoe byuro* political bureau] (1925) : the principal policy-making and executive committee of a Communist party

po·lite \pə-'līt\ *adj* **po·lit·er; -est** [L *politus*, fr. pp. of *polire*] (1501) **1 a :** of, relating to, or having the characteristics of advanced culture **b :** marked by refined cultural interests and pursuits esp. in arts and belles lettres **2 a :** showing or characterized by correct social usage **b :** marked by an appearance of consideration, tact, deference, or courtesy **c :** marked by a lack of roughness or crudities ⟨uses terms seldom met with in ~ literature⟩ *syn* see CIVIL — **po·lite·ly** *adv* — **po·lite·ness** *n*

po·li·tesse \,päl-i-'tes, ,pō-li-\ *n* [F, fr. MF, cleanness, fr. OIt *pulitezza*, fr. *pulito*, pp. of *pulire* to polish, clean, fr. L *polire*] (1717) : formal politeness : DECOROUSNESS

pol·i·tic \'päl-ə-,tik\ *adj* [ME *politik*, fr. MF *politique*, fr. L *politicus*, fr. Gk *politikos*, fr. *politēs* citizen — more at POLICE] (15c) **1 :** POLITICAL **2 :** characterized by shrewdness in managing, contriving, or dealing **3 :** sagacious in promoting a policy **4 :** shrewdly tactful *syn* see EXPEDIENT, SUAVE

po·lit·i·cal \pə-'lit-i-kəl\ *adj* [L *politicus*] (1551) **1 a :** of or relating to government, a government, or the conduct of government **b :** of, relating to, or concerned with the making as distinguished from the administration of governmental policy **2 a :** of, relating to, or involving politics and esp. party politics **b :** adept at, sensitive to, or engrossed in politics ⟨highly ~ students⟩ **3 :** organized in governmental terms ⟨~ units⟩ **4 :** involving or charged or concerned with acts

EXHIBIT C

Webster's Third New International Dictionary

OF THE ENGLISH LANGUAGE

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multiple sclerosis *n* : a chronic progressive disease of the central nervous system marked by patchy demyelination and hardening of nerve tissue and associated with varied motor and psychic changes depending upon the location of the lesions
multiple shop *or* **multiple store** *n*, *Brit* : CHAIN STORE
multiple-speed transmission *n* : transmission that provides a choice of gear ratios between the motor and the shaft or axle finally driven
multiple standard *n* : TABULAR STANDARD
multiple star *n* : several stars in close proximity that appear to form a single system
multiple switchboard *n* : a manual telephone switchboard in the jack field of which some or all subscriber lines appear more than once so as to be within reach of all operators
multiple synchronous telegraph *n* : a multiplex telegraph in which at the receiving station apparatus is maintained in exact synchronism with corresponding apparatus at the sending station
mul·ti·plet \'məltəplət\ *n* -s [ISV 1*multiple* + -*et*] : a spectrum line having several components
multiple thread *n* : a screw thread composed of two or more distinct parallel intertwined threads or helices
multiple-tuned \;==;=\ *adj* : tuned to more than one frequency or by more than one circuit or element — usu. used of antennas or electrical networks
multiple-unit \'==,==\ *adj* : of or relating to a system of electric traction in which two or more cars controlled from a single car are used to propel a train (as in commuter service)
multiple voting *n* **1** : voting by the same individual at the same election in various places in each of which he possesses the legal qualifications **2** : unauthorized and illegal voting by one person in two or more constituencies (as voting by floaters)
multiple watermark *n* : a watermark on a stamp that consists of more than one or portions of more than one unit of design
1**mul·ti·plex** \'məltə,pleks\ *adj* [L *multiplex* — more at MULTIPLE] **1** : having numerous parts or elements : MANIFOLD, MULTIPLE ⟨the ~ moods of our human nature —Herbert Read⟩ ⟨giants and the genii, ~ of wing and eye —G.K. Chesterton⟩ **2** : being or relating to a system of transmitting several messages or signals simultaneously on the same circuit (as in telephony or telegraphy) or on the same channel (as in radio or television) ⟨favored the development and use of ~ sound and facsimile broadcasting —*Proceedings of the Institute of Radio Engineers*⟩
2**multiplex** \"\ *vb* -ED/-ING/-ES *vt* : to send (several messages or signals) by a multiplex system ~ *vi* : to multiplex messages or signals ⟨granted permission for FM stations to test stereo ~*ing*, a system that sends the two separate signals over a single radio frequency —*Time*⟩
3**multiplex** \"\ *n* -ES **1** : a multiplex system **2** : a stereoscopic instrument used in preparing topographic maps by projecting aerial photographs onto a surface so that the projected images when viewed with anaglyphic spectacles give a three-dimensional effect
mul·ti·plex·er *or* **mul·ti·plex·or** \-sə(r)\ *n* -s [2*multiplex* + -*er*] : a device for multiplex transmission of signals
mul·ti·pli·able \'məltə,plīəbəl, ,==;===\ *adj* [F, fr. OF, fr. *multiplier* to multiply + -*able* — more at MULTIPLY] : capable of being multiplied
mul·ti·plic·a·ble \,məltə'plikəbəl\ *adj* [ME, fr. ML *multiplicabilis*, fr. L *multiplicare* to multiply + -*abilis* -able] : MULTIPLIABLE
mul·ti·pli·cand \,məltəplə'kand, -aa(ə)nd\ *n* -s [L *multiplicandum* something to be multiplied, neut. of *multiplicandus*, gerundive of *multiplicare* to multiply] : the number that is to be multiplied by another number — compare MULTIPLIER
1**mul·ti·pli·cate** \'məltəplə,kāt\ *adj* [ME, fr. L *multiplicatus*, past part. of *multiplicare* to multiply] **1** : consisting of many or of more than one : MULTIPLE, MULTIFOLD ⟨~ forms⟩ **2** : having many folds ⟨~ shells⟩
2**multiplicate** \"\ *n* -s : the form or condition of being exactly reproduced in many copies ⟨have copies made in ~⟩
mul·ti·pli·ca·tion \,məltəplə'kāshən\ *n* -s [ME *multiplicacioun*, fr. MF *multiplication*, fr. L *multiplication-*, *multiplicatio*, fr. *multiplicatus* (past part. of *multiplicare* to multiply) + -*ion-*, -*io* -ion — more at MULTIPLY] **1 a** : the act or process of multiplying ⟨combat the weevil and prevent its ~ —*Encyc. Americana*⟩ ⟨the ~ and distribution of a printed and bound message —B.L.Stratton⟩ **b** : the state of being multiplied ⟨this ~ of security investigations is institutionalized —H.J.Morgenthau⟩ ⟨when the converter is developing its greatest torque ~ —Joseph Heitner⟩ **2 a** : a mathematical operation commonly indicated by *ab*, *a·b*, or *a×b* and having various significances according to the type of numbers involved, the simplest being in the case of positive integers where the process is that of repeating *b* as many times as there are units in *a* or vice versa **b** : the mathematical process involving an operand and an operator each of which may consist of various kinds of numbers, symbols, expressions, assemblages, or magnitudes and in which the operand is affected by the operator in a manner governed by defined laws some of which are usu. the same as those that apply to the multiplication of numbers even when numbers are not involved ⟨the ~ of derivatives to yield derivatives of derivatives⟩ **3** : the logical operation of forming a conjunction or product — rarely used outside the algebra of classes
multiplication dance *n* : a mixer in American social dances starting with one couple and multiplying by continual choice of new partners
multiplication factor *n* : the ratio of the number of neutrons produced in a nuclear pile to the number disappearing that must equal or exceed unity for a chain reaction to take place — called also *reproduction constant*, *reproduction factor*
multiplication table *n* : a table of the products of a set of

MULTIPLICATION TABLE

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

numbers multiplied in some regular order; *usu* : a table of the products of the first 10 or 12 integers multiplied successively by 1, 2, 3, etc., up to 10 or 12
1**mul·ti·pli·ca·tive** \,məltə'plikəd·iv, -əti; 'məltəplə,kād·i, -ēti; [ēv *also*]əv\ *adj* [LL *multiplicativus*, fr. L *multiplicatus* (past part. of *multiplicare* to multiply) + -*ivus* -ive] : tending or having the power to multiply numbers ⟨the ~ tendency of proportional representation —Barbara & Robert North⟩ ⟨a ~ scale of monetary weight units —A.L.Kroeber⟩ — **mul·ti·pli·ca·tive·ly** \ivlē, -li\ *adv*
2**multiplicative** *n* -s : a numeral adjective (as *single*, *treble*, *twofold*) denoting how many times something is taken
mul·ti·pli·ca·tor \'məltəplə,kād·ə(r)\ *n* -s [LL, fr. L *multiplicatus* (past part. of *multiplicare* to multiply) + -*or*] : MULTIPLIER ⟨provides the necessary circulation in a ~ circuit —Anna Akeley⟩
multiplicious *adj* [L *multiplic-*, *multiplex* multiple + E -*ious*] *obs* : MULTIPLEX, MANIFOLD
mul·ti·plic·i·ty \,məltə'plisəd·ē, -ətē, -i\ *n* -ES [MF *multiplicité*, fr. LL *multiplicitat-*, *multiplicitas*, fr. L *multiplic-*, *multiplex* multiple + -*itat-*, -*itas* -ity] **1** : the quality or state of being multiple, manifold, or various : multiple or multiform character : MULTIFARIOUSNESS ⟨try to reduce the incomprehensible ~ of the universe to a comprehensible simplicity —F.L.Mott⟩ ⟨the ~ and heterogeneity of our environment —Hunter Mead⟩ ⟨there is a vast ~ of duty for the squadron commander —H.H.Arnold & I.C.Eaker⟩ **2** : a great number ⟨a ~ of interesting paths crossed the featureless land —E.E. Shipton⟩ ⟨booklet is unfortunately marred by a ~ of minor errors —R.S.Churchill⟩ **3 a** : the number of components or sublevels in a given electronic multiple-energy state **b** : the number of components of a multiplet
mul·ti·pli·er \'məltə,plī(ə)r, -īə\ *n* -s [ME, fr. *multiplien* to multiply + -*er*] : one that multiplies: as **a** : a number by which another number is multiplied — compare MULTIPLICAND **b (1)** : an instrument or device for multiplying or intensifying some effect ⟨~ phototube⟩ — compare VOLTAGE MULTIPLIER **(2)** : MULTIPLYING COIL **c (1)** : a set of gears causing the spool of a fishing reel to revolve faster than the crank thereby accelerating the speed at which the fishing line is reeled in **(2)** *or* **multiplier reel** *or* **multiplying reel** : a reel so equipped **d** : a key-operated machine or a key-operated mechanism or circuit on a machine (as on a calculating machine) that multiplies figures and records the products **e (1)** : one of the underground bulbils or offsets by which a multiplier onion increases — compare TOP ONION **(2)** *chiefly NewEng* : WINTER ONION; *esp* : MULTIPLIER ONION **f** : a factor in the game of skat that is derived by adding 1 for each matador held by the bidder or his opponents, 1 for fulfilling or failing to fulfill the contract, and 1 each for schneider or schwarz and predation thereof and that is used by multiplying by the base value of a game to determine the total score **g** : the ratio of the income held to result from an addition to investment to the amount of such addition ⟨the ~, which began as an analysis of the effects of public spending, has thus broadened into a general concept of income formation⟩ — compare ACCELERATOR
multiplier onion *n* : any of several perennial garden onions that constitute a variety (*Allium cepa* var. *aggregatum*) of the common onion and are grown chiefly for salad onions
1**mul·ti·ply** \'məltə,plī\ *vb* -ED/-ING/-ES [ME *multiplien*, fr. OF *multiplier*, fr. L *multiplicare*, fr. *multiplic-*, *multiplex* multiple — more at MULTIPLE] *vt* **1** : to increase in number esp. greatly or in multiples : make more numerous : add quantity to : AMPLIFY, AUGMENT ⟨the spread of such a prejudice may ~ readers —R.P.Blackmur⟩ ⟨no organized attempt to ~ good writings —G.G.Coulton⟩ ⟨when an original manuscript could only be *multiplied* by handwritten copies —G.F.Hudson⟩ ⟨inspiring other property owners to ~ their prices —Louise Levitas⟩ ⟨ask you not to ~ those errors into misfortunes for all of us —Irving Stone⟩ ⟨commerce *multiplied* wealth and comfort —Stringfellow Barr⟩ **2 a** : to find the product of : perform multiplication on **b** : to combine with (another number) by multiplication **3** *obs* : MAGNIFY ~ *vi* **1 a** : to become greater in number : increase in extent : SPREAD ⟨as time passed, the forges and the furnaces *multiplied* —Desmond Sprague⟩ ⟨the natural secrecy in which errors breed and ~ —Norman Cousins⟩ **b** : BREED, PROPAGATE ⟨every species of animals naturally *multiplies* in proportion to the means of their subsistence, and no species can ever ~ beyond it —Adam Smith⟩ ⟨allows virus to ~ more than a millionfold —*Monsanto Mag.*⟩ **2** : to perform the mathematical operation of multiplication **syn** see INCREASE — **multiply the earth** : to add to the world's population ⟨front soldiers who have just returned from killing and destruction now begin calmly to *multiply the earth* as though nothing had happened —Lawrence Thompson⟩ — **multiply words** : to be verbose or garrulous ⟨a fool *multiplies words* —Eccles. 10: 14 (RSV)⟩
2**mul·ti·ply** \'məltəplē, -li\ *adv* [1*multiple* + -*ly*] : in a multiple manner : in several or many ways : in multiple ⟨the use of ~ applicable names —A.I.Melden⟩ ⟨that physical objects are ~ accessible to different people —J.W.Yolton⟩
mul·ti-ply \'məltə,plī\ *adj* [*multi-* + *ply*, n.] : composed of several or many plies ⟨*multi-ply* nylon⟩ ⟨*multi-ply* glass⟩
mul·ti·ply·ing \'məltə,plīiŋ\ *adj* [ME *multeplyinge*, fr. pres. part. of *multeplien*, *multiplien* to multiply] : that multiplies ⟨the ~ train in a timepiece⟩ ⟨~ camera⟩
multiplying coil *n* : a resistor connected in parallel with an ammeter or in series with a voltmeter and so adjusted that the readings of the instrument must be multiplied in a fixed ratio (as 10: 1) to give the correct value — called also *multiplier*
multiplying reel *n* : MULTIPLIER c(2)
mul·ti·polar \;== *at* MULTI- +\ *adj* [ISV *multi-* + *polar*] : having several poles: as **a** : having several dendrites ⟨~ nerve cells⟩ **b** : having a number of pairs of magnetic poles of alternate north and south polarity ⟨a ~ electric machine⟩ — **mul·ti·polarity** \"+\ *n*
1**mul·ti·pole** \'məltə,pōl\ *adj* [*multi-* + *pole*, n.] : MULTIPOLAR ⟨~ radiation field⟩
2**multipole** \"\ *n* [ISV *multi-* + *pole*] : a system (as a molecule) involving two or more pairs of electric or magnetic dipoles and having an electric or a magnetic moment
mul·tip·o·tent \,məl'tipəd·ənt\ *adj* [L *multipotent-*, *multipotens*, fr. *multi-* + *potent-*, *potens* potent — more at POTENT] : having power to do many things ⟨~ goblins gyrated in a danse macabre —Saul Carson⟩ ⟨the synthesis of new ~ derivatives —*Jour. Amer. Med. Assoc.*⟩
mul·ti·purpose \;məltə+,-\ *adj* [*multi-* + *purpose*, n.] : having several purposes ⟨~ dam⟩ ⟨~ furniture⟩
mul·ti·racial \;== *at* MULTI- +\ *adj* [*multi-* + *racial*] : of, relating to, or representing various races ⟨~ government⟩
mul·ti·seriate \"+\ *adj* [prob. fr. (assumed) NL *multiseriatus*, fr. NL *multi-* + (assumed) NL *seriatus* seriate] : consisting of or arranged in several or many series
mul·ti·spiral \"+\ *adj* : having several whorls
mul·ti·stage \'məltə,stāj\ *adj* [*multi-* + *stage*, n.] **1** : having successive operating stages ⟨~ compressor⟩ ⟨~ pump⟩ ⟨~ turbine⟩; *specif* : having two or more propulsion units that operate in turn ⟨~ rocket⟩ **2** : conducted by stages ⟨~ amplification⟩ ⟨~ milling⟩ ⟨a ~ investigation⟩ ⟨~ sampling⟩
mul·ti·story \'məltə+,-\ *adj* [*multi-* + *story*, n.] : having a number of stories ⟨a ~ parking garage⟩; *esp* : having a floor plan that is repeated on levels above the ground floor ⟨a ~ hotel⟩
mul·ti·syllabic \;== *at* MULTI- +\ *adj* [*multi-* + -*syllabic*] : POLYSYLLABIC
mul·ti·syllabicity \,məltə,silə'bisəd·ē\ *n* [*multisyllable* + -*ity*] : the quality or state of being multisyllable
mul·ti·syllable \'məltə+,-\ *n* [*multi-* + *syllable*] : a word of many syllables
mul·ti·tentacled \"+\ *adj* [*multi-* + *tentacled*] : having several tentacles
mul·ti·tubercular \;== *at* MULTI- +\ *adj* [*multi-* + *tubercular*] : MULTITUBERCULATE
mul·ti·tu·ber·cu·la·ta \,məltətə,bərkyə'läd·ə, -lād·ə\ *n pl, cap* [NL, fr. neut. pl. of *multituberculatus* multituberculate] : an order of relatively small Mesozoic and Eocene mammals with multituberculate teeth coextensive with the subclass Allotheria and resembling the rodents although not considered ancestral to any recent mammals
1**mul·ti·tuberculate** \;== *at* MULTI- +\ *adj* [NL *multituberculatus*, fr. *multi-* + *tuberculatus* tuberculate] **1** *of teeth* : having many simple conical cusps **2** : of or relating to the Multituberculata **3** : of or relating to multituberculy
2**multituberculate** *n* -s : a mammal of the order Multituberculata
mul·ti·tu·ber·cu·lism \,məltətə'bərkyə,lizəm\ *n* -s [*multituberculate* + -*ism*] : MULTITUBERCULY
mul·ti·tu·ber·cu·ly \-,lē\ *n* -ES [*multituberculate* + -*y*] : the state of having many tubercles — used esp. in ref. to a theory of the origin of mammalian teeth; compare TRITUBERCULY
mul·ti·tude \'məltə,tüd, -tə-,tyüd\ *n* -s [ME, fr. MF or L; MF, fr. L *multitudo*, fr. *multi-* + -*tudo* -tude] **1** : the state of being many : NUMEROUSNESS ⟨whereas you were as the stars of heaven for ~ —Deut. 28:62 (RSV)⟩ ⟨the mind falters, confused by the ~ and yet the harmony of the detail —Theodore Dreiser⟩ ⟨of large numbers, note whether they are used precisely, or merely to express ~ —*Notes & Queries on Anthropology*⟩ **2** : a great number : HOST ⟨~s in the valley of decision —Joel 3:14 (RSV)⟩ ⟨love covers a ~ of sins —1 Pet 4:8 (RSV)⟩ ⟨a language in which the same sound has to stand for a ~ of ideas —Edward Clodd⟩ ⟨a ~ of stories and traditions grew up around his name —D.E.Smith⟩ **3** : a great number of persons collected together : CROWD, THRONG ⟨all the ~ was astonished —Mk 11:18 (RSV)⟩ ⟨the tourist buses disgorged their ~s —Mollie Panter-Downes⟩ **4** : POPULACE, PUBLIC ⟨both scorns and seeks the understanding and approbation of the ~ —Arthur Knight⟩ ⟨does not like his defeat in a matter of the heart to be known, and needs must dissemble to the ~ —Rex Ingamells⟩
mul·ti·tu·di·nal \;məltə;tüdᵊnəl, -tə-;tyü-\ *adj* [L *multitudin-*, *multitudo* multitude + E -*al*] : MULTITUDINOUS
mul·ti·tu·di·nism \-ᵊ'tüdᵊn,izəm, -'tyü-\ *n* -s [L *multitudin-*, *multitudo* multitude + E -*ism*] : a doctrine or policy giving primary importance to the interests of the multitude as opposed to the individual
mul·ti·tu·di·nous \;məltə;tüdᵊnəs, -tə-;tyü-\ *adj* [L *multitudin-*, *multitudo* multitude + E -*ous*] **1** : including a multitude of individuals : POPULOUS ⟨the invasion of nature by ~ man —H.S.Canby⟩ ⟨in the ~ city —W.S.Maugham⟩ **2** : existing in a great multitude : MYRIAD ⟨the mosquitoes were ~ and fierce —Claud Cockburn⟩ ⟨evaluates the ~ happenings of the day —F.L.Mott⟩ ⟨lunch of ~ hors d'oeuvres —Jean Stafford⟩ **3** : existing in or consisting of innumerable forms, particles, elements, or aspects ⟨filling the air with a ~ musical clamor —John Burroughs⟩ ⟨urgent demand upon my attention made by the ~ world around me —Richard Church⟩ ⟨the long ~ rain —Carl Sandburg⟩
mul·ti·tu·di·nous·ly *adv* : in a multitudinous manner
mul·ti·tu·di·nous·ness *n* -ES : the state or quality of being multitudinous ⟨the ~ of their wants —Douglas Rimmer⟩
mul·ti-unit tube \'məltə+,- . . . -\ *n* [*multi-unit* fr. *multi-* + *unit*, n.] : a single electron tube that contains in one envelope elements enabling it to perform the functions of two or more separate tubes
mul·ti·va·lence \,məltə'vālən(t)s\ *n* -s [fr. 1*multivalent*, after such pairs as E *absent*: *absence*] **1** *or* **mul·ti·va·len·cy** \-nsē\ : POLYVALENCE **2** : the quality or state of having many values, meanings, or appeals ⟨while ~ in the sense of appeal to different periods can not be demonstrated —*Western Rev.*⟩ ⟨the admission of relativity and ~ does not make value illusory or judgment futile —H.J.Muller⟩ ⟨the ~ of his imagery —James Burnham⟩
1**mul·ti·va·lent** \;== *at* MULTI- +\ *adj* [ISV *multi-* + *valent*] **1** : POLYVALENT **2** : MULTIPLE — used of homologous chromosomes when more than two are present and associate in synapsis **3** : having many values, meanings, or appeals ⟨even in the field of the terminal values of form, a work of art is ~ —George Boas⟩ ⟨as great and ~ a poet —Ramon Guthrie⟩
2**multivalent** \"\ *n* -s : one that is multivalent; *esp* : a multivalent chromosome group
mul·ti·valued \"+\ *adj* [*multi-* + *valued*] : having several or many values
1**mul·ti·valve** \'məltə+,-\ *adj* [NL *multivalvis*, fr. *multi-* + -*valvis* (fr. *valva* valve)] : having many valves — used esp. of shellfish and shells
2**multivalve** \"\ *n* : a multivalve shellfish or shell
mul·ti·variant \;== *at* MULTI- +\ *adj* [*multi-* + *variant*, adj.] : having more than two degrees of freedom — used esp. of a physical-chemical system; compare PHASE RULE
mul·ti·variate \"+\ *adj* [*multi-* + *variate*, n.] : having or involving a number of independent mathematical variables — used esp. in statistical analysis
mul·ti·various \"+\ *adj* [*multi-* + *various*] : widely diverse
mul·ti·verse \'məltə,vərs\ *n* -s [*multi-* + -*verse* (as in *universe*)] : a totality of things and forces that are disparate or lacking in ultimate unity ⟨neither a universe pure and simple nor a ~ pure and simple —William James⟩ ⟨the part that mind plays in changing individuals and their ~ —Maynard Whitlow⟩ — compare PLURIVERSE
mul·ti·vibrator \,məltə+\ *n* [ISV *multi-* + *vibrator*] : a radio-frequency oscillator that produces a controlled fundamental frequency but distributes its energy chiefly among several harmonic or subharmonic frequencies
mul·ti·vin·cu·lar \;məltə;viŋkyələ(r)\ *adj* [*multi-* + *vinculum* + -*ar*] : having several small separate ligaments — used of the hinge of various bivalves
mul·tiv·i·ous \,məl'tivēəs\ *adj* [L *multivius*, fr. *multi-* + -*vius* (fr. *via* way, road) — more at VIA] : having many ways or roads
1**mul·ti·vitamin** \;== *at* MULTI- +\ *adj* [*multi-* + *vitamin*, n.] : containing or employing several vitamins
2**multivitamin** \"\ *n* : a multivitamin preparation
mul·tiv·o·cal \,məl'tivəkəl\ *adj* [*multi-* + -*vocal* (as in *equivocal*)] **1** : signifying many things : of manifold meanings : EQUIVOCAL ⟨meet with an ambiguous or ~ word —S.T. Coleridge⟩ **2** [*multi-* + *vocal*] : VOCIFEROUS ⟨so bustling and ~ in pacifism —F.L.Paxson⟩ ⟨scandals and horrors of the moment in ~ . . . clamor —S.H.Adams⟩
mul·ti·vol·tine \;məltə;vōl,tēn, -,tᵊn\ *adj* [*multi-* + -*voltine* (as in *bivoltine*)] : having several broods in a season — used esp. of an insect
mul·ti·volume \;== *at* MULTI- +\ *or* **mul·ti·volumed** *adj* [*multi-* + *volume* (n.) or *volumed*] : comprising several volumes ⟨a ~ atlas⟩
1**mul·ti·wall** \'məltə,wȯl\ *adj* [*multi-* + *wall*, n.] : having a wall made up of several layers ⟨moisture-resistant ~ bags⟩
2**multiwall** \"\ *n* : a multiwall bag
mul·ture \'məlchə(r)\ *n* -s [ME *multyr*, *multer*, fr. OF *molture*, lit., grinding, fr. (assumed) VL *molitura*, fr. L *molitus* (past part. of *molere* to grind) + -*ura* -ure — more at MEAL] *chiefly Scot* : a fee in the form of money, grain, or meal paid to a land proprietor or a tenant miller for the grinding of grain
mul·tur·er \-ərə(r)\ *n* -s **1** *chiefly Scot* : one who has grain ground at a mill **2** *chiefly Scot* : a miller to whom multure is paid
1**mum** \'məm\ *adj* [prob. imit. of a sound made with closed lips] : having no speech : SILENT ⟨to all of which I listened, ~ as an oyster —Carleton Beals⟩ ⟨officially he is still ~ on the subject —*Newsweek*⟩ — often used interjectionally to express a desire or need for silence
2**mum** \"\ *n* -s : abstention from speaking : SILENCE — often used in the expression *mum's the word*
3**mum** \"\ *vb* **mummed**; **mummed**; **mumming**; **mums** [ME *mommen*, fr. MF *momer* to go masked] *vi* **1** : to act or play (as in a pantomime) usu. in mask or disguise ⟨miserable *mumming* on the stage —Donn Byrne⟩ **2** : to go about merrymaking in disguise esp. during festivals ⟨the crowds *mumming* in the streets at Mardi Gras⟩ ~ *vt* : to make (one's way) esp. in disguise during festivals ⟨with soot-blackened faces and grotesque attire, *mumming* their way . . . singing for sixpences —A.J.Cronin⟩
4**mum** \"\ *n* -s [G *mumme*] : a strong ale or beer orig. made in Brunswick, Germany
5**mum** \"\ *chiefly Brit var of* MOM
6**mum** \", ,məm, ,əm\ *n* -s [alter. of *ma'am*] : MADAM
7**mum** \'məm\ *n* -s [by shortening] : CHRYSANTHEMUM
1**mum·ble** \'məmbəl\ *vb* **mumbled**; **mumbled**; **mumbling** \-b(ə)liŋ\ **mumbles** [ME *momelen*, of imit. origin] *vt* **1** *archaic* : to chew something gently with closed lips or with little use of the teeth **2** : to make speech sounds that are hard to understand because of minimal displacement of the speech organs from their rest position : utter words in a low confused indistinct manner : MUTTER ⟨he lay . . . gray and limp, with a parson *mumbling* over him —Francis Yeats-Brown⟩ ~ *vt* **1** : to utter with a low inarticulate voice ⟨*mumbled* something about not having a license —George Meredith⟩ **2** : to chew or bite with or as if with toothless gums ⟨the old women *mumbling* soft sandwiches —A.P.Gaskell⟩ **3** : to press or caress with the lips ⟨she *mumbled* his cheek and called him "lovey" —Robertson Davies⟩ **4** *chiefly dial Eng* : MOMBLE
2**mumble** \"\ *n* -s : a low confused indistinct utterance : MUTTERING ⟨the ~ of his voice vanished —Gwyn Thomas⟩
mumblebee \'==,=\ *n* -s [origin unknown] : a sloop-rigged Devonshire fishing boat with a mast stepped far aft, a large foresail, and a jib
mumblenews \'==,=\ *n pl but sing or pl in constr* : TALEBEARER
mum·bler \'məmb(ə)lə(r)\ *n* -s **1** : one that mumbles **2** *Brit* : GLASSBLOWER

EXHIBIT D

REDACTED

EXHIBIT E
REDACTED

EXHIBIT F
REDACTED

EXHIBIT G

REDACTED

EXHIBIT H
REDACTED

EXHIBIT I
REDACTED

EXHIBIT J

Page 1

IN THE UNITED STATES DISTRICT COURT

IN AND FOR THE DISTRICT OF DELAWARE

APPLERA CORPORATION, MDS, INC., and APPLIED BIOSYSTEMS/MDS SCIEX, — CIVIL ACTION

Plaintiffs

vs

MICROMASS UK LTD. and MICROMASS, INC.,

Defendants — NO. 2000-105 (RRM)

- - -

Wilmington, Delaware
Thursday, December 13, 2001
2:00 o'clock, p.m.

- - -

BEFORE: HONORABLE RODERICK R. McKELVIE, U.S.D.C.J.

- - -

APPEARANCES:

MORRIS, NICHOLS, ARSHT & TUNNELL
BY: JULIA HEANEY, ESQ.

-and-

Valerie J. Gunning
Official Court Reporter

Page 2

APPEARANCES (Continued):

KENYON & KENYON
BY: JAMES GALBRAITH, ESQ.,
WALTER E. HANLEY, JR., ESQ.,
LEWIS V. POPOVSKI, ESQ.,
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-and-

LATHAM AND WATKINS
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KEVIN C. MAY, ESQ.
(Chicago, Illinois)

Counsel for Defendants

- - -

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P R O C E E D I N G S

(Proceedings commenced in the courtroom, beginning at 2:00 p.m.)

THE COURT: Good afternoon.
Shall we do some introductions first?
MS. HEANEY: Good afternoon, your Honor. Julie Heaney, for the plaintiff.
We have Walter Hanley, Jim Galbraith, Lewis Popovski and Huiya Wu and Jeffrey Ginsberg, of Kenyon & Kenyon.
THE COURT: Okay. Good afternoon.
MR. WHETZEL: Your Honor, Bob Whetzel, for defendant Micromass.
We're outnumbered by a few, but with me is Jim Hunter, Ken Schuler and Kevin May, from Latham.
I'd also like to introduce some representatives of Micromass that are in the back of the courtroom. Mr. Bob Williams, who's Chairman of Micromass, Mr. Norman Lynaugh, who's a Managing Director, David Yorke, who's the I.P. Manager for Micromass.
THE COURT: Nice to see everybody.
MR. HANLEY: Your Honor, just one more. I'd

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be remiss in not according the AB/Sciex representative. Also, we have Andrew Karnakis, who's patent counsel at AB/Sciex.
THE COURT: Good.
So why don't I get two victims up and we'll talk about what we want to do and how we want to do it. And that lectern is only there because the lawyers during closing argument end up leaving it there. Usually, it floats back over here.
In light of current conditions, meaning the fact that I bumped you out of this morning to this afternoon, and that we have a number of things to get done, let me make some suggestions, and then we'll see whatever suggestions you have about it. My thought is that we do claim construction and then, to the extent that we have time left over, we'll let people pick a topic that they'd like to address and we'll just go back and forth on topics.
We're not going to get everything done today. I know we've got a trial coming up, pretrial conference coming up, and at least from my perspective the priority is going to be to get claim construction done, get an opinion out as soon as I can and to offer the suggestion we get back together as soon as I get claim construction out and have further argument and see what the claim

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see how that works out

MR HUNTER Starting what time, your Honor?

THE COURT If people come in from out of town, would you rather do it

MR HUNTER I think we're afraid to try it on the day in question, so the morning would be fine

MR HANLEY That's fine with us

THE COURT That may be a snow day, too

MR HUNTER: Another reason we're afraid

THE COURT In between now and January 31st, any time anybody wants to talk about a case, we can get together on the phone and have the conversation about it.

I expect I will get claim construction out in time for everybody to get it and read it and digest it before the 31st

MR. HUNTER: Thank you, your Honor

MR HANLEY: Thank you, your Honor, very much

THE COURT: Claim construction.

MR HANLEY: Right

THE COURT: How do you want to do it?

MR. HANLEY: I think we're the plaintiffs, it's our patent Our proposal would be we go first We have a very minor subset of the issues, 20 issues before the Court because, if we attempted to address everything, we think it would be like fast-forwarding through a movie.

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And so we have a couple of issues we want to address and use our time to do that

THE COURT: All right Do you have any comments on what you'd like to do?

MR. HUNTER: I'm content for plaintiffs to go first, your Honor

THE COURT: All right Typically, what I do is pick an issue and have each side talk about it I don't want to prevent one side from making the presentation they want to make.

So why don't we start with them making plaintiffs' presentation If you want to engage them, great If you want to just do your presentation, fine.

In terms of where I am on preparation, I've been on a death March of trials for about a month, and so you should assume I start with a blank slate on views about the relations of the parties And it's not that we aren't familiar with what the issues are, it's just that I can't tell you that I'm going to engage you too much in it, because I've been distracted. All right?

MR HUNTER: Thank you, your Honor

THE COURT: So that may be good or bad

MR HANLEY: All right. May it please the Court, as I said, I intend to address a minor subset Not minor in the sense of importance, believe me, but we have

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some 20-plus terms And what I would like to present in terms of the claim construction issues is argument on just two of them They are what I will call the first and second issue, and they're also -- the second one is the meaning of the means for maintaining cometic energies of ions at a relatively low level

So I intend to talk about what is in elements 1A, 1C and 1K of Claim 1 and their corresponding terms to some degree in Claim 14 as well, which are two independent claims

I start with a precept that I think we can all agree on, and that is claims are construed from the standpoint of a person of ordinary skill in the art And that being the case, it seems to us that a patent, typically, would be read by the person of ordinary skill in the art from the beginning to the end. So from that sense, what I'd like to do by way of background and also by way of foundation for some of the remarks when we get to the terms in particular, is talk a bit about the invention as it's described in the specification

So, first, I would like to start with Figure 12, which is one of the two preferred embodiments of the mass spectrometer that is operated in the manner described in the patent in order to achieve the improved ion transmission

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Looking at Figure 12, what we've done, just to have a convention that will not confuse us in comparing this to other things, including prior art, if we get to that, is have the -- we reverse the figure so that the ion flow goes from left to right, instead of right to left, as it's shown in the patent. But, other than that, this is figures with the numbers that appear on it in the patent.

And starting at the beginning on the left here, we have what is referred to in the patent as the ion source, 16 prime. This is where the ions are generated Analyte substance that is to be analyzed is ionized and then the ions traverse a path through the instrument to this destination And this is the mass filter for the ions The mass filter essentially does what the name implies: It will filter out ions, depending on their mass-to-charge ratio, and permit some ions to pass through to this detector, which is shown schematically here (indicating) for analysis, and basically inject all the other ions that are not of interest.

And the mass filter can be tuned by adjusting the DC voltage so that a mass, ions of a mass-to-charge ratio in a particular range can be examined by passing them to the detector for analysis.

Now, the manner in which this operates is -- it's not at the core of the patent here This is not a

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before the Quattro Ultima was designed, there was some correspondence between the parties regarding another instrument or at least an instrument in development about which Micromass had published a paper. In the course of that correspondence, a letter was written back identifying certain prior-art references. And Micromass has said in their brief that at that time -- this is in 1997 -- they read the claims, in particular, these terms, the very same way that we read them and are urging the Court, how we're urging the Court to construe them.

Do we have their brief?

This is in Micromass' opening brief. And the Micromass points out that, this is in the context of discussing this 1997 correspondence. They say, Micromass suggested that, for purposes of evaluating the validity of the '736 patent, one could ignore the precise arithmetic sequence and location of the rod sets and vacuum chambers in the prior art, so long as the second vacuum chamber and rod set followed the first vacuum chamber and rod set. As noted, that is the very claim construction plaintiffs urge the Court to adopt herein.

So back in 1997, they didn't view the plain meaning of these terms to confine them to the very first and the very second. They believed that the construction was as we now urged it in this case.

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So we submit that the plain meaning argument really does not apply here. That, in fact, the plain meaning of the terms is as we had proposed. And the question then becomes: Did that change? Did the re-examination prosecution change what was otherwise the plain meaning and the scope of these terms?

And to put it in perspective, it's useful to look at the standard that the Court applies in examining now the question of whether or not the re-examination prosecution changed the scope of the claims from what it was when they were issued.

This is a page from the York Products versus Central Tractor case, which we cited, and in the opinion, the Court says, unless altering claim language to escape an examiner rejection. Okay.

So unless there is an amendment to the claims, a patent applicant only limits claims during prosecution by clearly disavowing claim coverage.

Now, in this case, as in York Products, there was no claim amendment.

So that being the case, there's no amendment in the original prosecution and none in the re-examination. That being the case, the standard that we apply in looking at the re-examination prosecution is: Was there a clear disavowal of claim coverage? And we submit that one reads

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the re-examination prosecution and one does not find it clear to disavow the claim coverage by any means.

Now, the argument that Micromass relies on primarily are arguments that were made in the request for re-examination that initiated a re-examination proceeding. And they rely in particular on arguments that were directed to three prior-art references. One was the so-called French application. One was the Caldecourt article. And the other was the Finnigan article.

And in all three, a similar set of arguments were made in distinguishing each because basically they're similar. The apparatus in each case is a so-called tandem mass spectrometry, and one that has a three-stage mass analyzer.

So the points that were being made, since the instruments in these references operated similarly, the points that were being made by way of distinction were similar points. And so I think it's sufficient here to look at the arguments that were made concerning the French application, that those appear to be -- that the primary emphasis is on Micromass' position that there was a narrowing of claims.

So if we can have -- let's take a look at French first.

This is a Figure 1 from the French application,

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which was before the patent examiner in their re-examination. And just for ease of illustration, we've colored up some of the sections of this.

We see, looking at the instrument in toto, on the left-hand side, we see what's labeled an ion source 36, and then an aperture 34 to which ions pass into this housing, which has basically three stages. And three stages we colored in green, red in the middle and blue at the end.

But the first stage, which we colored green here, is a mass filter for the ions that are generated in the source.

This is a quadrupole and consists of four rods. Has the AC and DC voltages applied to it. Its function, again, is to filter out ions that are not of interest, that are generated in a source.

We then pass to the -- this middle stage, which is called a collision cell. And the function of the collision cell is to take the ions that pass through this initial mass filtering stage and to fragment them into fragments or daughter ions, and they are then passed onto the -- a second mass filtering stage, that we've colored in blue, and there, that mass filtering stage will select from the fragments, fragments of a ratio that are of interest to analysis. They're then

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a half millitorr and higher

Now, there's a pressure and voltage discussion And what does it say? You got between 40 and a hundred and more than two and a half millitorr? We have 2,460 We're higher than two and a half millitorr by far, and we are 50 to 120 volts The only thing that the patent discloses is if you do what we do, you can't practice the invention The only place pressure is discussed in conjunction with voltage at the same time

One owe one The ion tunnel

Next? This is the ion tunnel This is not a rod set, your Honor, but the plaintiffs accuse it of being It is our current product The first two rod sets in the Quattro Ultima have been replaced by this device

Next?

The claim requires, the Claims both 1 and 14, a first rod set, which are elongated rods. They have to be elongated, spaced laterally apart, spaced laterally apart

Back one

They are not elongated I think they're about a quarter of -- quarter of a centimeter? Millimeter? How many? Okay. They are not elongated, your Honor They're very thin.

This is the whole length of the original rod

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set. These are very thin They are not spaced laterally apart They are spaced longitudinally apart

Now, 105 Schaff is an ion trap. The plaintiffs admit, admitted in the Patent Office and admitted in this case, the Schaff has electrodes They wanted to distinguish Schaff because it discloses collisional focusing. What did they say? Schaff differs from the invention in that, for instance, it does not disclose the application of AC-only voltage to the first rod set. But Schaff does apply AC-only voltage to its electrodes, as they admit and the reference discloses The Schaff ion electrodes have AC-only voltage applied to them and they use quite a high pressure and they collision naturally focus the ions in order to trap them, the very basis of this patent So they want to distinguish it It doesn't disclose AC-only voltage to the first rod set Well, it does disclose AC-only voltage to the electrodes, the rod sets to the electrodes

This statement can only be true if the patent requires that the only electrode that you apply AC-only voltage to is a rod set, because if you could apply AC-only voltage to something other than a rod set, and infringe the patent, Schaff is prior art that can't be distinguished on this basis

They admit that they -- that Schaff has

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AC only voltage, but they say its electrode isn't a rod set

So in the re-exam, to get away from the ion traps, they say we have rod sets. Well, we don't have rod sets in the ion tunnel, your Honor

And 107?

See what Dr Douglas has to say when you say to him, talking about that statement about Schaff: You understand, as one working in the field of mass spectrometry, that that refers to the -- that, meaning the Schaff statement, refers to the application of RF voltages, RF or AC's, RF voltages to the trap electrodes; correct?

Yes

And you would agree with me that this statement, then, at least the portion I am focusing on, is incorrect?

Can we go back to that statement, Will? It's No 105

This is the statement So you would agree with me that this statement is incorrect? Okay. Forward to 107.

No, I don't agree. Why not? Because it says the application of AC-only voltage to a rod set. If Schaff had a 3-D trap, it wouldn't have rods, it would ha

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a different electrode structure.

We don't have rods. We have ion tunnels.

108? And here they are. This is what plaintiffs say is our first rod set (indicating). By the way, this is what is the second (indicating).

109 On top of that, not only is it not a rod set, but the ion tunnel generates field in three dimensions. Longitudinally, radially, upward Both radially, but horizontally and vertically.

Rod sets don't do that. Rod sets generate a field in only two dimensions.

In their answering brief to our summary judgment motion, with regard to the ion tunnel, the plaintiffs make much of the fact that when they were distinguishing Schaff, all they were really saying was not that it was an electrode point, it was had a that Schaff is an ion trap and, therefore, it generates fields in three dimensions. When they said that in their answering brief, they missed the fact that that is also true for the ion tunnel.

So their explanation of what they were sayin about Schaff, even if it were true, would still exclu the ion tunnel from being something that this claim language can read on, because the ion tunnel has three-dimensional electric field, just as Schaff does.

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I'm puzzled by the argument concerning the interchamber orifice They have said they initially took the position that the interchamber orifice is in a wall the wall is stated as separating the first and second vacuum chambers We understood their position to be that that meant that you could only have a wall in between the first and second vacuum chambers and we made arguments directed to that, as to why the claims say, don't say they're separated only by a wall

And in response to that, the defendant said in their answering brief, that's not what we're saying at all They said, our arguments are misdirected, because Micromass does not claim that the phrase separated by a wall itself rules out inclusion of additional structure

Well, it seems to me now, hearing the argument today, that that phrase does rule out additional structure, and that's just contrary to what they said in their brief

And on the issue of improved transmission of ions, this really is -- it's an issue of fact Our expert witness, in our Interrogatory Answer, if you read it, it says a way or the ion transmission may be measured by measuring ion current in a manner described.

It didn't limit the way in which infringement can be proven. In fact, Dr. Enke, in his expert report,

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addresses that issue and basically says there are -- there's evidence that shows that there's collisional focusing in this stage and therefore, as a result of thatpresent, ion transmission is improved.

What you've heard today is simply an attempt to raise an issue of fact which, you know, results in -- in denial of their motion, not the grant of their motion.

So, your Honor, we commend you to the briefs on that point.

Now, one other point on this maintaining kinetic energies at a low level. Mr Hunter referred to a passage in the specification where in the inventors explained that when they used DC difference voltages in the range of 40 to a hundred, they had a loss of ions and they went on and said, at 2.5 millitorr and higher, we had this loss of ion significant, with a DC difference voltage in that range

What Mr. Hunter did not point out was the highest pressure they tested was 70 millitorrs. The inventors weren't saying if you go from 2.5 millitorr up to infinity at these voltages, you'll get decreased ion transmission. They were saying within the context of the experiments we conducted, where we had a maximum pressure of 70 millitorr, at that voltage range, we had a loss of ion signal

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In fact, the Quattro Ultima is at a pressure that's much above the highest pressure the inventors tested and, therefore, notwithstanding that they have a higher range of voltages, their ion energy is low, as Mr Bateman explained in the deposition excerpt that they put up on the screen earlier today

In terms of the ion tunnel issue, it clearly is an issue of fact We don't contend that there is literal infringement We contend there's infringement by equivalents

The fact that the Schaff reference, which is an ion trap reference, was distinguished, has no bearing on this. They don't contend that their ion tunnel is an ion trap, like Schaff And it's not. It's an ion guide, just like the ion guide of the invention. It simply uses a different arrangement to provide the AC field than the rods The rings, center rings, is equivalent to the rod set in what it does It basically confines the ions to the cylindrical space defined by the ring set, just as a rod set confines ions to the cylindrical space defined by the rod set So it does the same thing.

It exerts a strong focusing effect.

Collisional focusing occurs and, therefore, we contend that it infringes under the doctrine of equivalents

Our expert has addressed that and the presentation in

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their briefs and today simply serves at most to raise an issue of fact for trial.

Now, if the Court has any more time, I think there's a couple points we'd like to address on inequitable conduct or we're out of time, we'll simply rest on the briefs

THE COURT: I'm just going to read the briefs, if that's okay I appreciate it.

I'm sorry to bump people.

MR. HANLEY: Thank you

THE COURT: Thank you for the presentations. So you'll hear from me. We'll see people in late January

(Court recessed at 6:05 p m.)

- - -

EXHIBIT K

PUBLIC COPY

Nos. 02-1334, 02-1459

United States Court of Appeals

FOR THE FEDERAL CIRCUIT

APPLERA CORPORATION, MDS INC., and APPLIED BIOSYSTEMS/MDS SCIEX,

Plaintiffs-Appellees,

—v.—

MICROMASS UK LTD. and MICROMASS INC.,

Defendants-Appellants.

ON APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE, CASE NO. 00-CV-105,
JUDGE RODERICK R. McKELVIE

BRIEF OF PLAINTIFFS-APPELLEES

FILED
U.S. COURT OF APPEALS FOR
THE FEDERAL CIRCUIT
OCT 1 2002
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reasoning that it would render the claim language "free of adhesive" superfluous. *Id.* at 704. This Court disagreed, holding that:

> [T]he expression "integrally bonded . . . free of adhesive" operates as a single limitation . . . defining a state of affairs with multiple terms should help, rather than hinder understanding. Being "integrally bonded" and "free of adhesive" are mutually reinforcing definitions rather than being superfluous.

Id. at 707. *See also, e.g., Ekchian v. Home Depot, Inc.*, 104 F.3d 1299, 1302-03 (Fed. Cir. 1997) (declining to find the word "conductive" in the claim element "conductive liquid-like medium" superfluous even though all liquids are conductive).

B. The District Court's Constructions of "Separated by a Wall" and "Interchamber Orifice" Are Correct

The district court construed "separated by a wall" to mean that "there is at least a wall between the first and second vacuum chambers" and "interchamber orifice" to mean "an orifice in a wall that is between the first and second vacuum chambers." (A120.) Micromass argues that these limitations require that the first and second vacuum chambers be separated only by a single wall, and that the interchamber orifice interconnect the two chambers. (Br. 23-27.) Again, Micromass seeks improperly to limit the claims to the preferred embodiments.

Micromass did not dispute the construction of "separated by a wall" below. Micromass stated that it did not contend that "the phrase 'separated by a wall'

itself rules out the inclusion of additional structure." (A8567; A8695; A8718.) Micromass cannot reverse course on appeal. *Interactive Gift Express, Inc. v. Compuserve, Inc.*, 256 F.3d 1323, 1346 (Fed. Cir. 2001) (waiver doctrine precludes "a party from adopting a new claim construction position on appeal"). Thus, Micromass's belated argument regarding the construction of "separated by a wall" should be rejected.

Moreover, Micromass's arguments are meritless. First, Micromass contends that because the abstract and description of the preferred embodiments contain no explicit suggestion that additional structures may intervene between the first and second vacuum chambers, the terms "separated by a wall" and "interchamber orifice" must be construed to preclude them. (Br. 24-25.) Micromass relies on the statement in reference to Figure 1 that "vacuum chamber 30 is *connected* by an interchamber orifice in a separator plate 36 to a second vacuum chamber 38." (Br. 24; A357, 4:24-26 (emphasis added).) This statement, however, merely describes the preferred embodiment of Figure 1. It does not purport to define all architectures in which the invention may be implemented. A patentee is not required to disclose all conceivable embodiments of the invention. *CCS Fitness*, 288 F.3d at 1366 ("[Federal Circuit] case law makes clear that a patentee need not 'describe in the specification every conceivable and possible future embodiment of

established "improved transmission," any further evidence of "improved transmission" would have been unnecessary and would not have been presented. AB/Sciex in fact presented other evidence; indeed, Micromass devotes a substantial part of its brief to attacking it. (Br. 42-56.) With respect to prior art, Micromass mischaracterizes Prof. Enke's testimony regarding the absence of improved ion transmission in the prior art collision cells, *e.g.*, the device in the French application. (Br. 36, 41.) Prof. Enke testified that because such a cell does not include a wall with an interchamber orifice to limit the passage of ions between the collision cell rod set and the second mass filter, the gas pressure in the collision cell is immaterial. (A12549-50, A13739-46, A13876-80, A13890-92.) With no orifice to limit the passage of ions, focusing ions into a beam does not improve transmission. (*Id.*)

B. Micromass's Proposed Construction of "Improved Transmission of Ions" Is Premised on a Mischaracterization of the Invention of the '736 Patent

Micromass has modified the construction it urged below by changing the benchmark of comparison from the number of ions that would be transmitted "without practicing the alleged invention" to the number transmitted "without practicing the PL product of the invention." (*Compare* A4537 *to* Br. 37.) The Court should not consider this new construction. *Interactive Gift Express, Inc.*,

Viewing the record as a whole in the light most favorable to AB/Sciex, there can be no doubt that substantial evidence supports the jury's finding that both versions of the Quattro Ultima achieve improved transmission of ions through the interchamber orifice. The evidence certainly is such "as might be accepted by a reasonable mind as adequate to support the finding under review." *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 893 (Fed. Cir. 1984).

IV. SUBSTANTIAL EVIDENCE SUPPORTS THE JURY'S FINDING THAT THE ION TUNNEL QUATTRO ULTIMA INFRINGES THE "ROD SET" LIMITATIONS UNDER THE DOCTRINE OF EQUIVALENTS

At trial, AB/Sciex proved that the ion tunnel Quattro Ultima literally meets each limitation of claims 1 and 14 of the '736 patent except the limitations relating to the "first rod set." (A13928; A14007-08.) The jury found, however, that the stacked ring set, *i.e.*, the ion tunnel, is equivalent to the first rod set. (A14008-09.) Micromass did not dispute, either before or after the verdict, that the ion tunnel performs the same function as the first rod set. (A13165-67; A13413; A217.) Micromass's JMOL motion contended that the evidence was insufficient to show that the ion tunnel guides ions in substantially the same way and achieves substantially the same result as the first rod set. (A14240-43; A217.) The district court correctly denied the motion, holding that substantial evidence supported

findings that the "way" and "result" elements of the "triple identity" test were met. (A218.) *See Warner-Jenkinson Co., Inc. v. Hilton-Davis Chemical Co.*, 520 U.S. 17, 39-40 (1997).

Here, Micromass takes an entirely different tack. Instead of arguing "way" and "result," Micromass produces a bulleted list of five differences between the ion tunnel and the first rod set and asserts that they are "far more than insubstantial." (Br. 57-58.) Micromass then focuses on one of these differences – that "[w]hereas the claims require 'a plurality of elongated parallel rod means spaced laterally apart' and 'extending longitudinally,' the ion guide of the ion tunnel has a stack of separate ring-shaped electrodes having no lateral spacing and none of which individually extends longitudinally." (Br. 57.) Micromass for the first time asserts that AB/Sciex presented no evidence that the ion tunnel has the equivalent of these claim limitations. (Br. 58.)

First, Micromass did not seek JMOL on this basis; this theory was not presented to the district court, and it cannot be presented for the first time on appeal. *Sage Products*, 126 F.3d at 1426.

Second, Micromass's new theory is completely undercut by the trial record. The record contains ample evidence, which Micromass simply ignores, of the structural equivalence between the ion tunnel and the first rod set. The following

chart shows the correspondence of the ion tunnel to the structure of the first rod set:

	Claim 1
"a plurality of elongated parallel rod means"	The ring set of the ion tunnel forms an elongated structure. (*See, e.g.*, A19733; A18450.) The length of the ring set is 12.5 cm, approximately the same as the length of the rod set in the hexapole Quattro Ultima for which the ring set was substituted. (A12466; A13164; A13259.)
"spaced laterally apart a short distance from each other to define an elongated space therebetween"	The rings of the ion tunnel are closely spaced and define an elongated space. (A18450; A12489-90.) Dr. March testified that the ion tunnel, like the first rod set, defines a space with cylindrical symmetry through which ions travel. (A13413.)
"extending longitudinally through such rod set"	The space defined by the rings of the ion tunnel extends longitudinally through the ring set. (A19733; A18450.)
	Claim 14[9]
"a plurality of rod means . . . defining [a] longitudinally extending . . . space[]"	The ion tunnel comprises a plurality of rings that define a longitudinally extending space. (A19733; A18450; A12489-90; A13413.)

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[9] Micromass does not differentiate between apparatus claim 1 and method claim 14. Claim 14 does not include the same recitations as claim 1 regarding the first rod set.

EXHIBIT L

US00RE34000E

United States Patent [19]

Syka et al.

[11] E Patent Number: Re. 34,000

[45] Reissued Date of Patent: Jul. 21, 1992

[54] METHOD OF OPERATING ION TRAP DETECTOR IN MS/MS MODE

[75] Inventors: John E. P. Syka, Sunnyvale; John N. Louris, Santa Clara; Paul E. Kelley; George C. Stafford, both of San Jose; Walter E. Reynolds, Woodside, all of Calif.

[73] Assignee: Finnigan Corporation, San Jose, Calif.

[21] Appl. No.: 499,947

[22] Filed: Mar. 27, 1990

Related U.S. Patent Documents

Reissue of:

[64] Patent No.: 4,736,101
Issued: Apr. 5, 1988
Appl. No.: 84,518
Filed: Aug. 11, 1987

U.S. Applications:

[63] Continuation of Ser. No. 738,018, May 24, 1985.

[51] Int. Cl.[5] H01J 49/42

[52] U.S. Cl. 250/292; 250/290; 250/282

[58] Field of Search 250/292, 291, 290, 282

[56] References Cited

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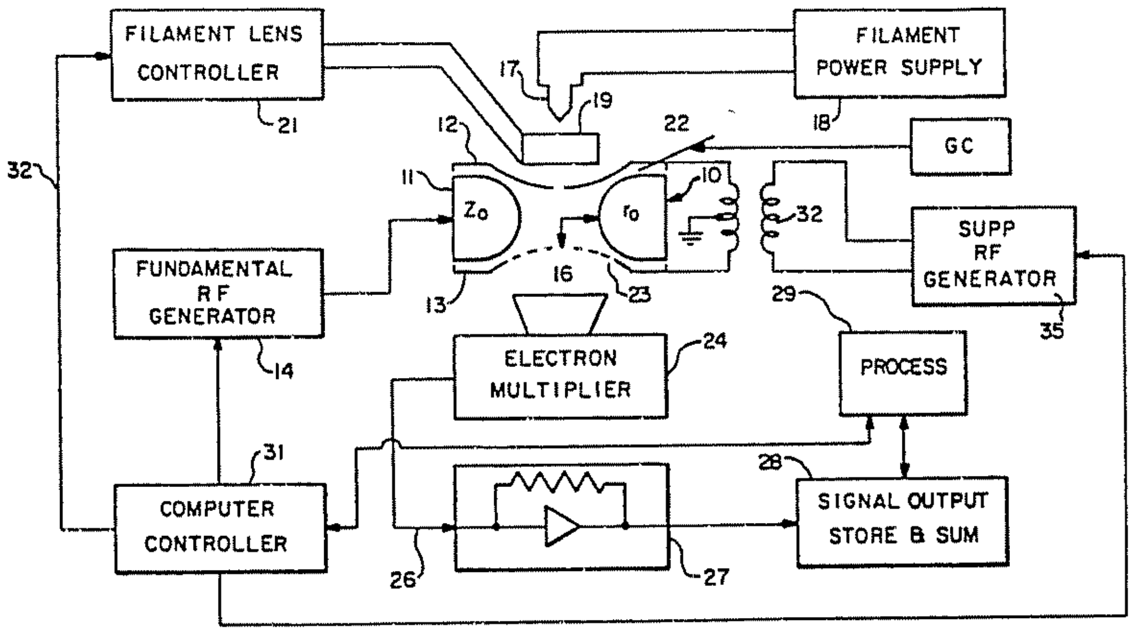
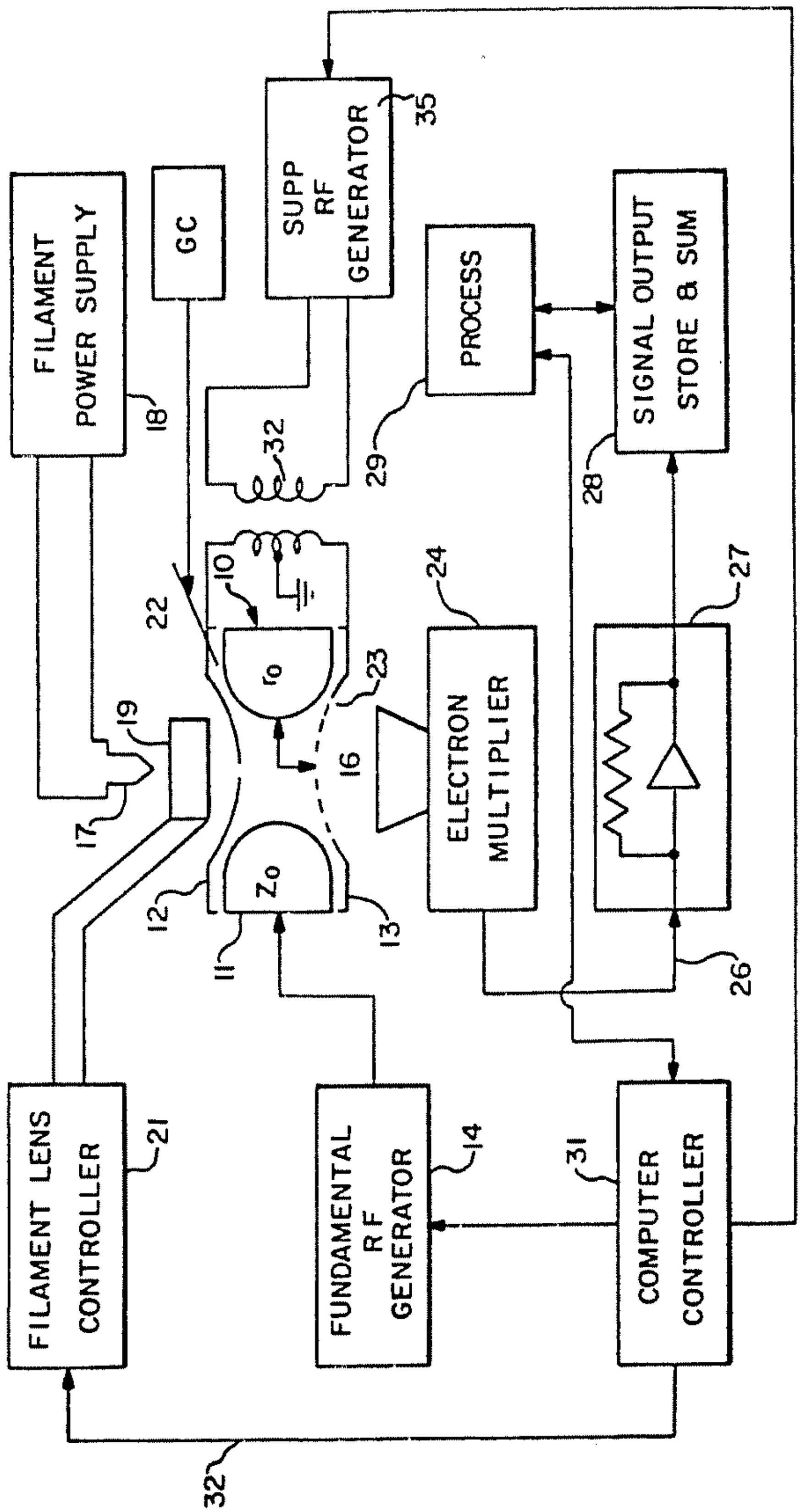
Primary Examiner—Jack I. Berman
Attorney, Agent, or Firm—Flehr, Hohbach, Test, Albritton & Herbert

[57] ABSTRACT

A simple and economical method of mass analyzing a sample by means of a quadrupole ion trap mass spectrometer in an MS/MS mode comprises the steps of forming ions within a trap structure, changing the RF and DC voltages in such a way that the ions with mass-to-charge ratios within a desired range will be and remain trapped within the trap structure, dissociating such ions into fragments by collisions and increasing the field intensity again so that the generated fragments will become unstable and exit the trap volume sequentially to be detected. A supplementary AC field may be applied additionally to provide various scan modes as well as dissociate the ions.

19 Claims, 7 Drawing Sheets




FILAMENT POWER SUPPLY
GC
SUPP RF GENERATOR
PROCESS
SIGNAL OUTPUT STORE & SUM
ELECTRON MULTIPLIER
FILAMENT LENS CONTROLLER
FUNDAMENTAL RF GENERATOR
COMPUTER CONTROLLER
r_o
Z_o
10
11
12
13
14
16
17
18
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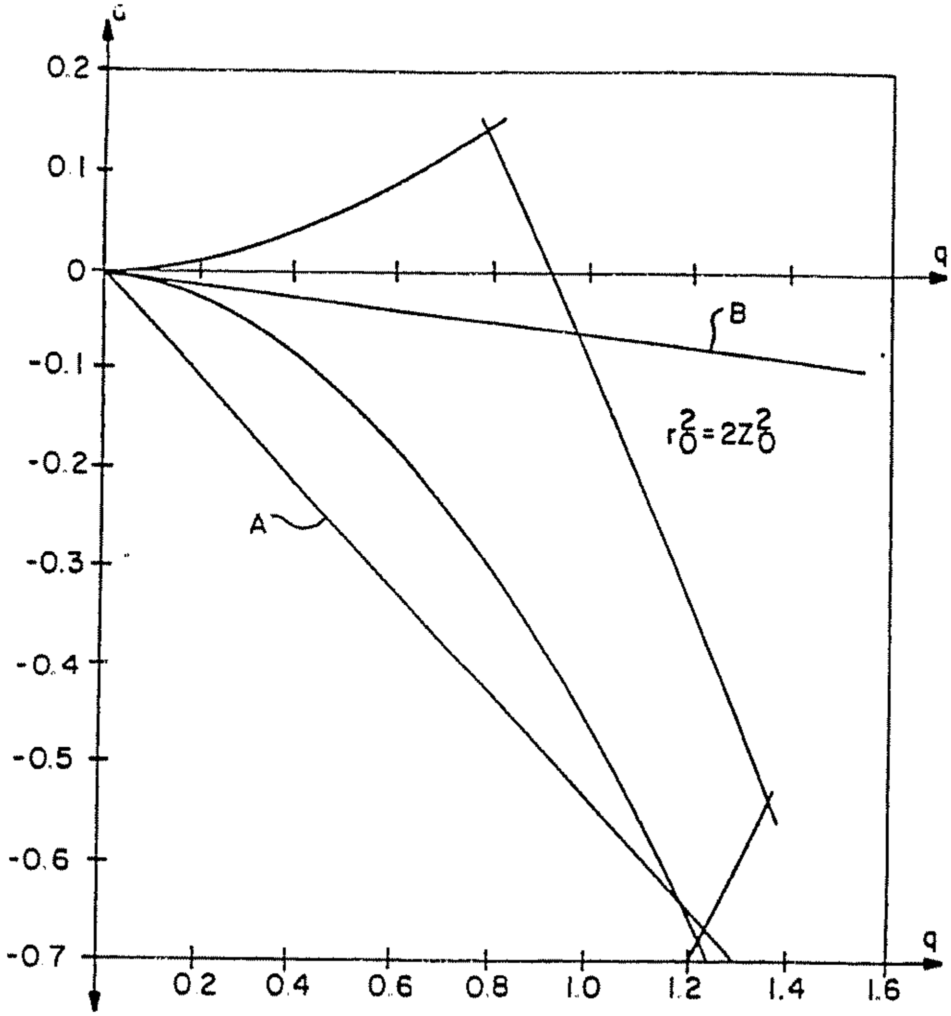
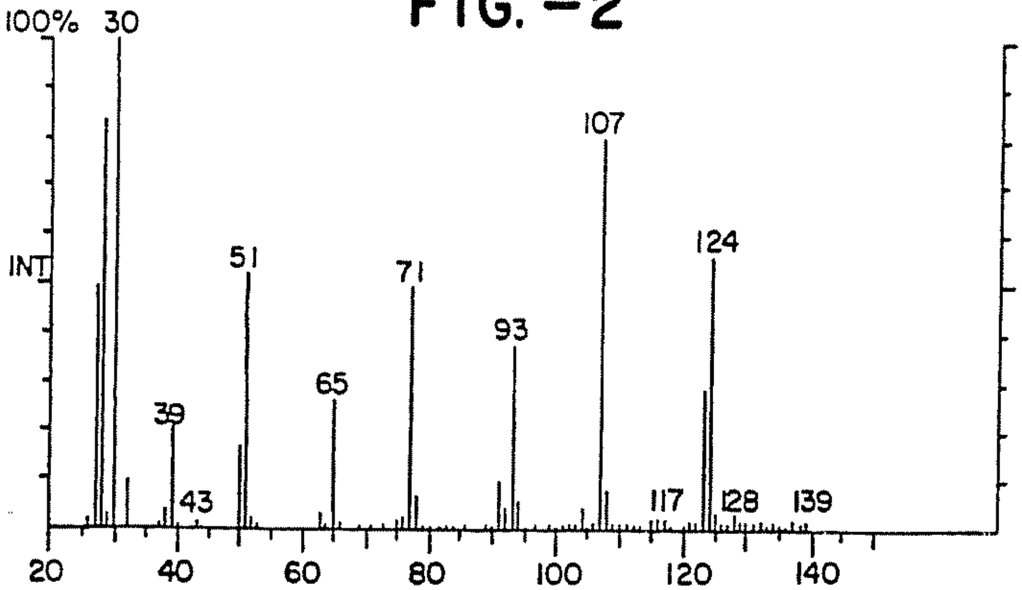
21
22
23
24
26
27
28
29
31
32
35

FIG.—1



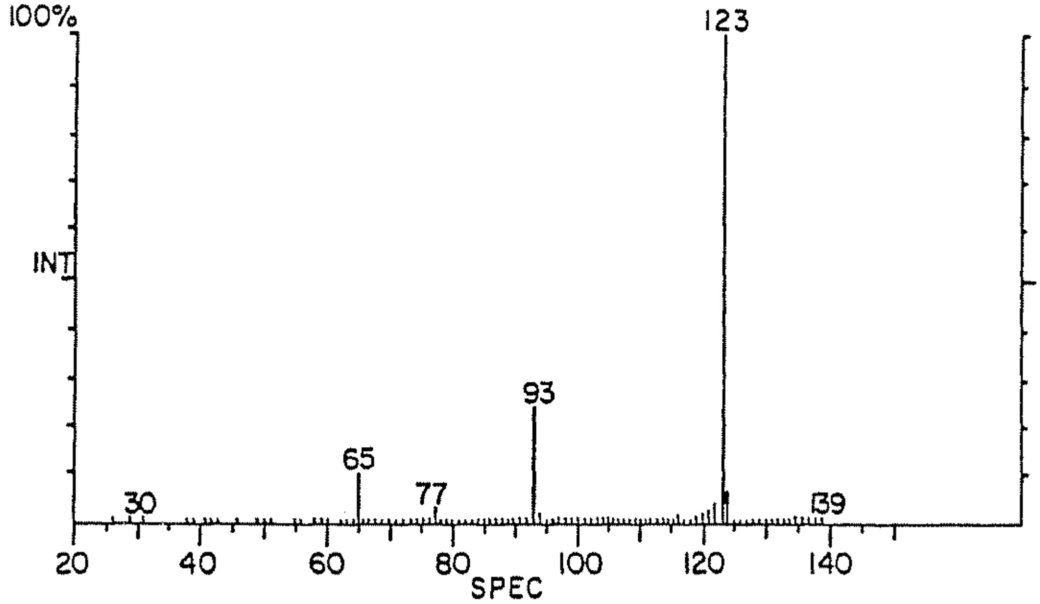
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
q
B
A
$r_0^2 = 2Z_0^2$
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6

FIG.—2



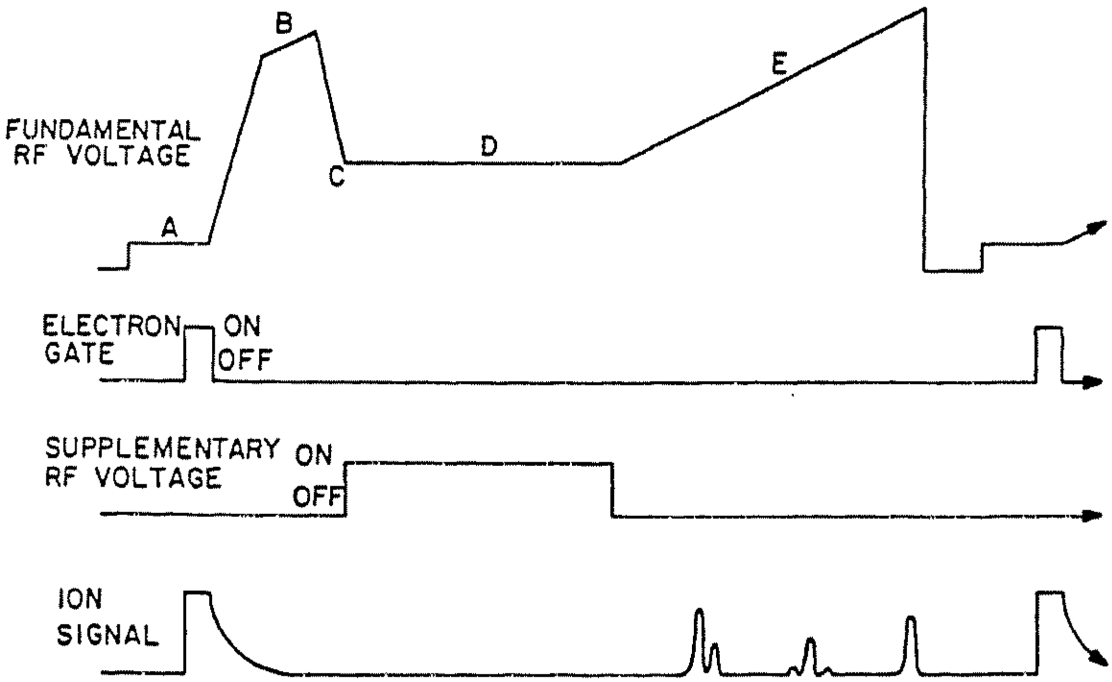
100%
INT
30
39
43
51
65
71
93
107
117
124
128
139
20
40
60
80
100
120
140

FIG.—3A



100%
123
INT
93
65
77
30
139
20
40
60
80
100
120
140
SPEC

FIG.—3B



FUNDAMENTAL RF VOLTAGE
A
B
C
D
E
ELECTRON GATE
ON
OFF
SUPPLEMENTARY RF VOLTAGE
ON
OFF
ION SIGNAL

FIG.—4

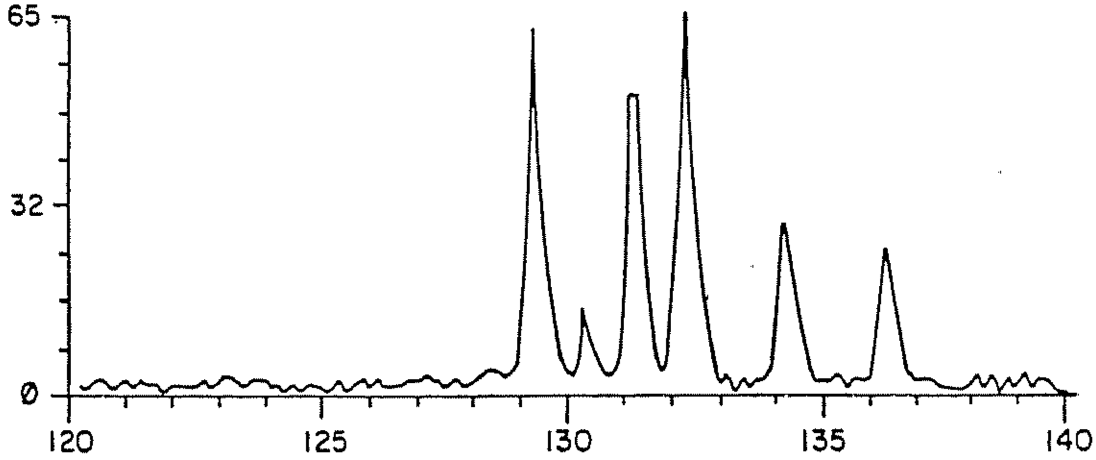


FIG. -5A

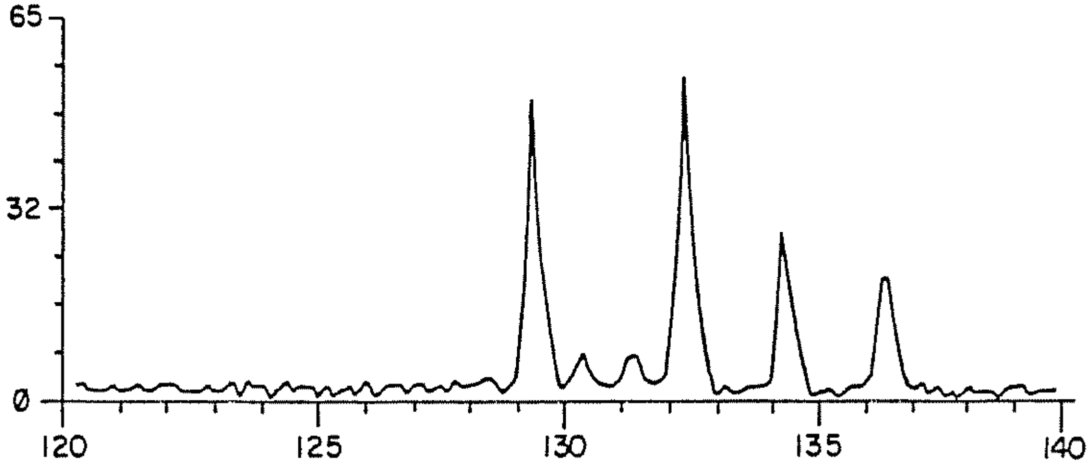


FIG. -5B

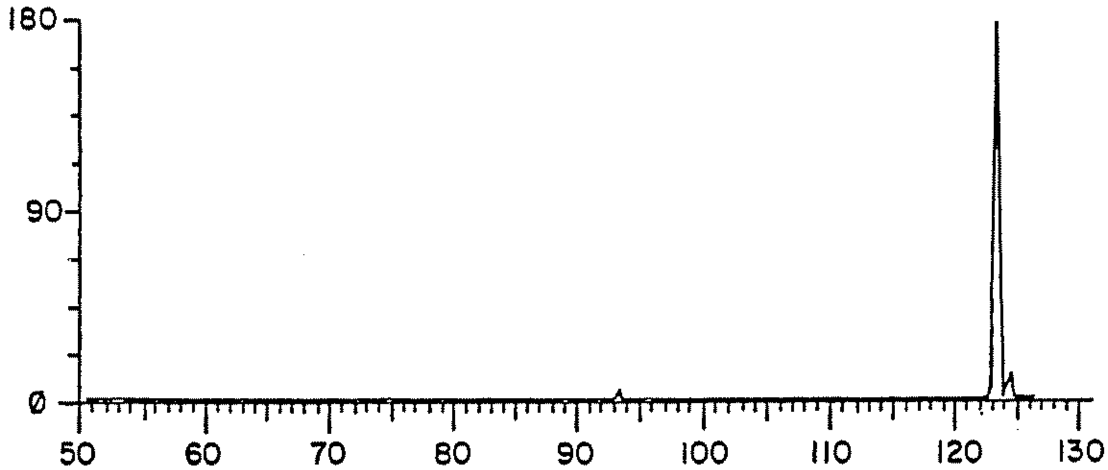


FIG. -6A

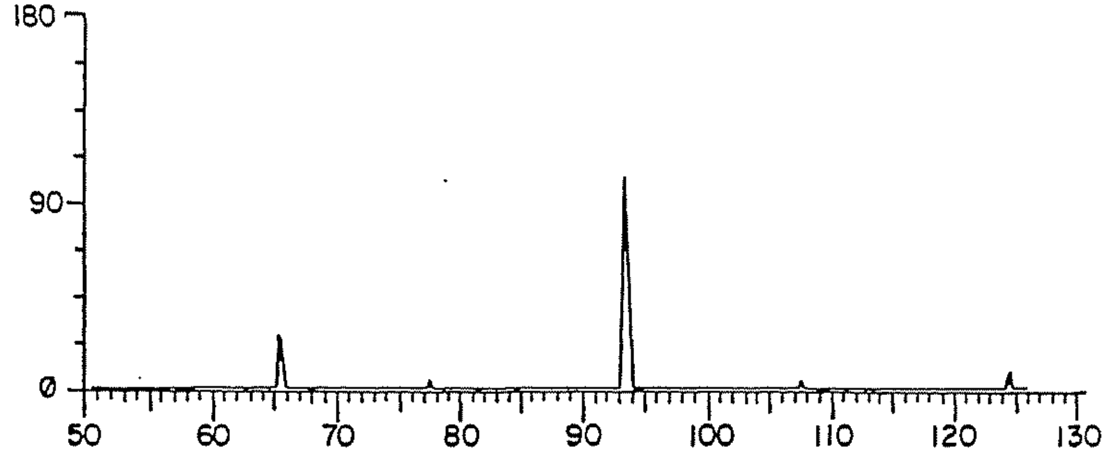


FIG.—6B

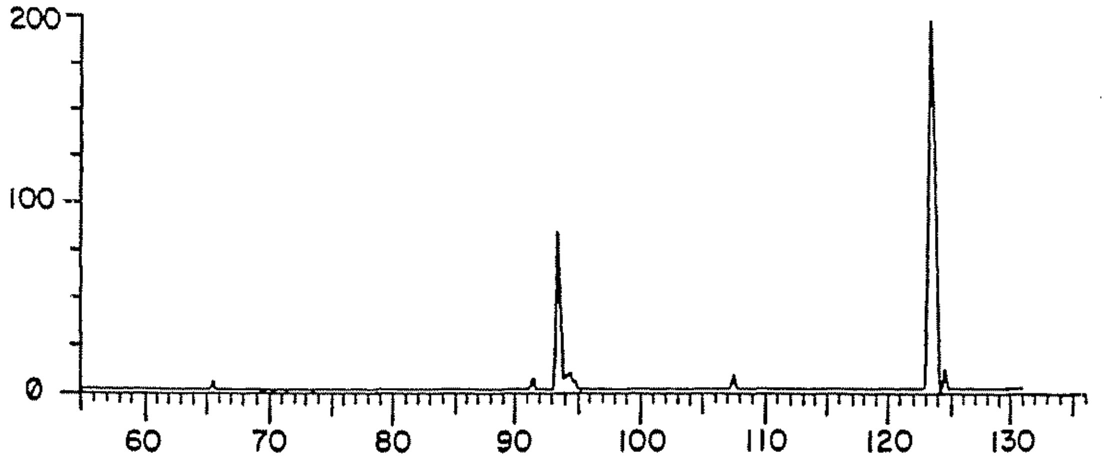


FIG.—6C

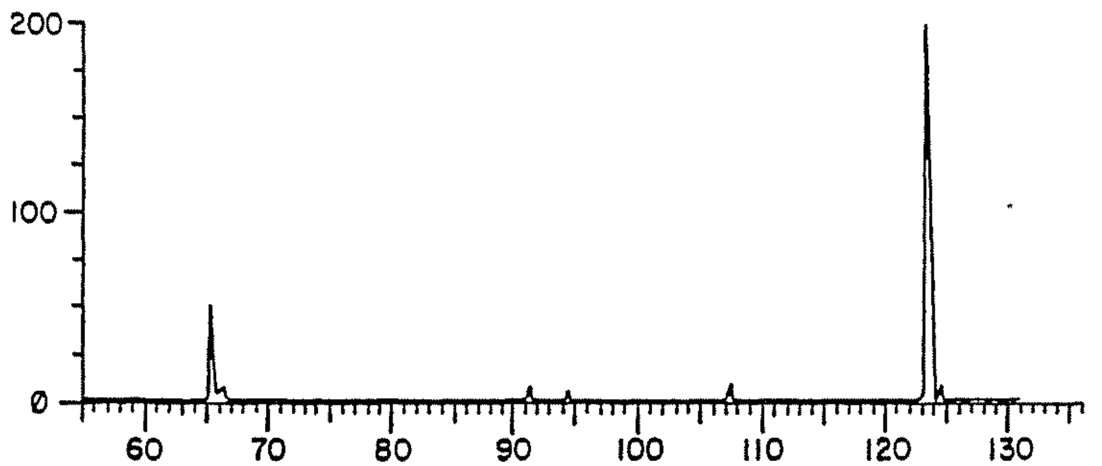


FIG.—6D

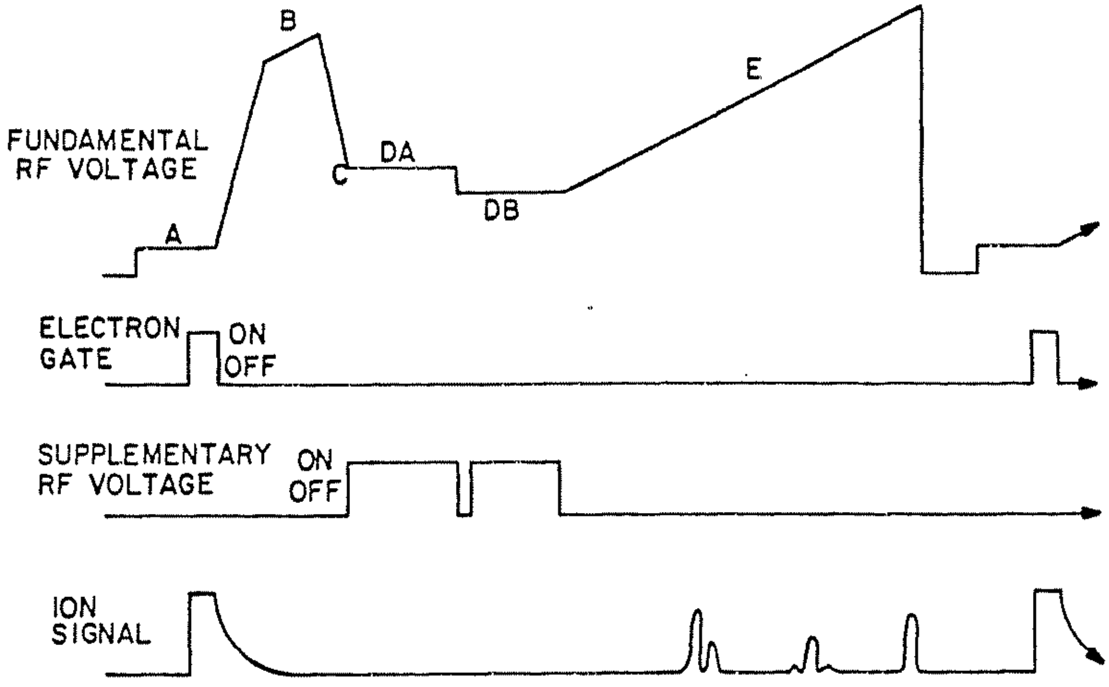

FUNDAMENTAL RF VOLTAGE
A
B
C
DA
DB
E
ELECTRON GATE
ON
OFF
SUPPLEMENTARY RF VOLTAGE
ON
OFF
ION SIGNAL

FIG. -7

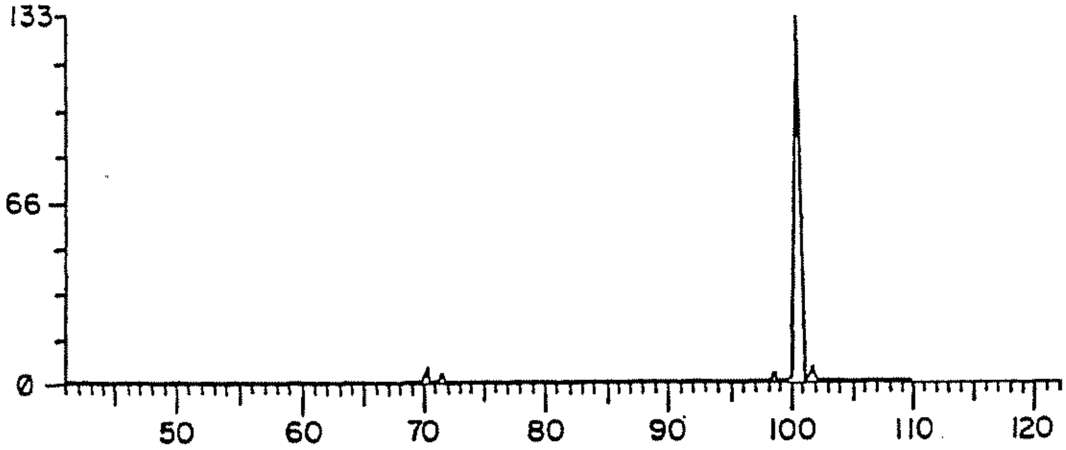

133
66
0
50
60
70
80
90
100
110
120

FIG. -8A

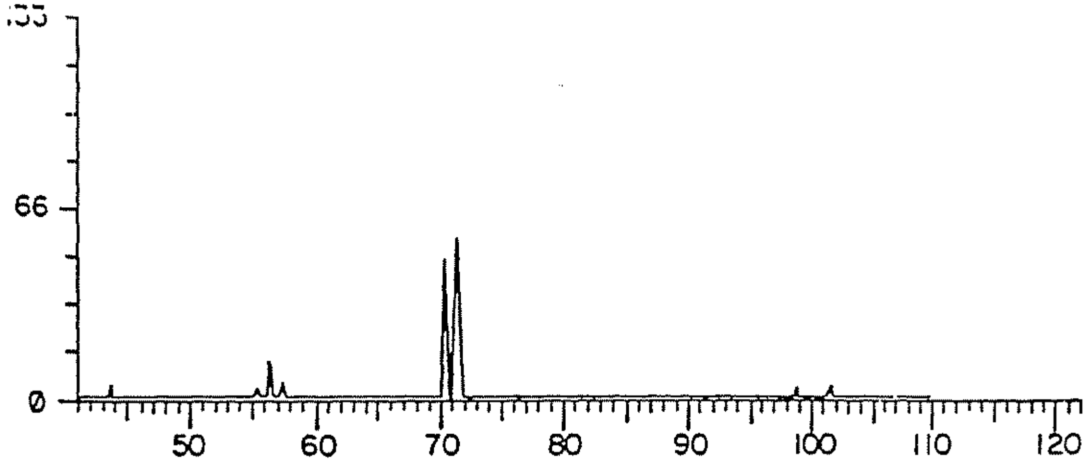


FIG.—8B

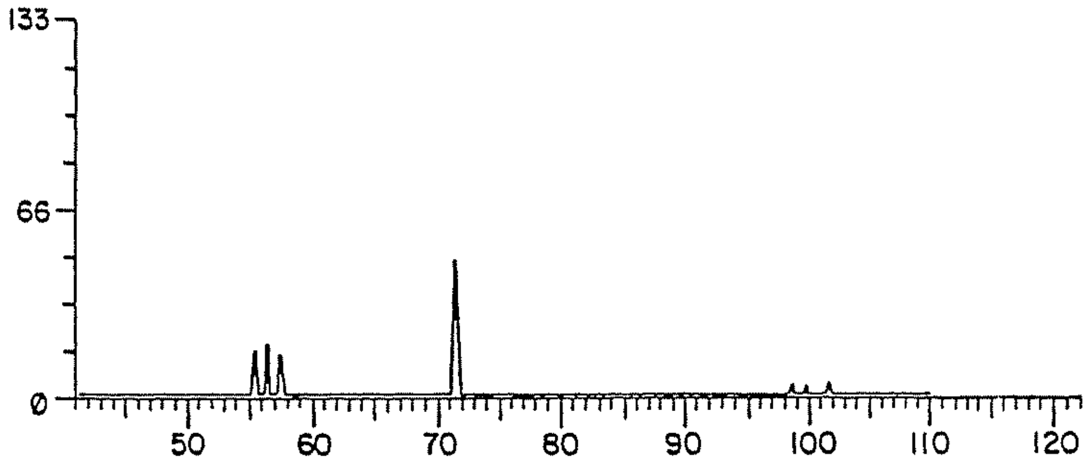


FIG.—8C

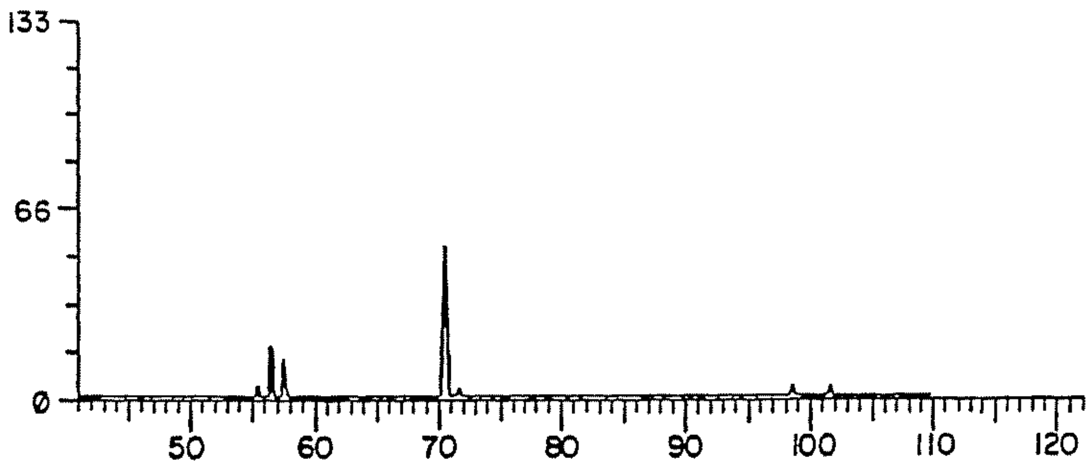


FIG.—8D

METHOD OF OPERATING ION TRAP DETECTOR IN MS/MS MODE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is a continuation of application Ser. No. 738,018 filed May 24, 1985.

The present invention relates to a method of using an ion trap in an MS/MS mode.

Ion trap mass spectrometers, or quadrupole ion stores, have been known for many years and described by a number of authors. They are devices in which ions are formed and contained within a physical structure by means of electrostatic fields such as RF, DC and a combination thereof. In general, a quadrupole electric field provides an ion storage region by the use of a hyperbolic electrode structure or a spherical electrode structure which provides an equivalent quadrupole trapping field.

Mass storage is generally achieved by operating trap electrodes with values of RF voltage V and its frequency f, DC voltage U and device size r_0 such that ions having their mass-to-charge ratios within a finite range are stably trapped inside the device. The aforementioned parameters are sometimes referred to as scanning parameters and have a fixed relationship to the mass-to-charge ratios of the trapped ions. For trapped ions, there is a distinctive secular frequency for each value of mass-to-charge ratio. In one method for detection of the ions, these secular frequencies can be determined by a frequency tuned circuit which coupled to the oscillating motion of the ions within the trap, and then the mass-to-charge ratio may be determined by use of an improved analyzing technique.

In spite of the relative length of time during which ion trap mass spectrometers and methods of using them for mass analyzing a sample have been known they have not gained popularity until recently because these mass selection techniques are insufficient and difficult to implement and yield poor mass resolution and limited mass range. A new method of ion trap operation (U.S. Pat. No. 2,939,952 and U.S. patent application Ser. No. 453,351 12-2982) has overcome most of the past limitations an is gaining popularity as a product called the Ion Trap Detector.

It is an object of this invention to provide a new method of operating an ion trap in a mode of operation called MS/MS.

In accordance with the above object there is provided a new method of using an ion trap in an MS/MS mode which comprises the steps of forming and storing ions in the ion trap, mass-selecting them by a mass analyzer, dissociating them by means of collisions with a gas or surfaces, and analyzing fragment ions by means of a mass or energy analyzer. *A supplementary AC field may be applied additionally to provide various scan modes for mass detection as well as to dissociate the ions.*

FIG. 1 is a simplified schematic of a quadrupole ion trap along with a block diagram of associated electrical circuits adapted to be used according to the method embodying the present invention.

FIG. 2 is a stability envelope for an ion store device of the type shown in FIG. 1.

FIGS 3(A) and 3(B) are spectrograms obtained by a series of experiments with a nitrobenzene sample by using the method of the present invention

FIG. 4 shows a program that may be used for a notchfilter scan mode with a supplementary voltage.

FIGS. 5(A) and 5(B) are spectrograms obtained with a xenon sample by using the method of FIG. 4.

FIG 6(A) through FIG. 6(D) are spectrograms obtained with a nitrobenzene sample by using the method of FIG. 4.

FIG 7 shows another program for an ion scan mode of the present invention.

FIG. 8(A) through FIG. 8(D) are spectrograms obtained with an n-heptane sample by a series of experiments in which both the methods of FIGS 4 and 7 are used.

There is shown in FIG 1 at 10 a three-dimensional ion trap which includes a ring electrode 11 and two end caps 12 and 13 facing each other. A radio frequency voltage generator 14 is connected to the ring electrode 11 to supply a radio frequency voltage V sin ωt (the fundamental voltage) between the end caps and the ring electrode which provides the quadrupole field for trapping ions within the ion storage region or volume 16 having a radius r_0 and a vertical dimension z_0 ($z_0^2 = r_0^2/2$). The field required for trapping is formed by coupling the RF voltage between the ring electrode 11 and the two end cap electrodes 12 and 13 which are common mode grounded through coupling transformer 32 as shown. A supplementary RF generator 35 is coupled to the end caps 22, 23 to supply a radio frequency voltage $V_2 \sin \omega_2 t$ between the end caps to resonate trapped ions at their axial resonant frequencies. A filament 17 which is fed by a filament power supply 18 is disposed to provide an ionizing electron beam for ionizing the sample molecules introduced into the ion storage region 16. A cylindrical gate electrode and lens 19 is powered by a filament lens controller 21. The gate electrode provides control to gate the electron beam on and off as desired. End cap 12 includes an aperture through which the electron beam projects. The opposite end cap 13 is perforated 23 to allow unstable ions in the fields of the ion trap to exit and be detected by an electron multiplier 24 which generates an ion signal on line 26. An electrometer 27 converts the signal on line 26 from current to voltage. The signal is summed and stored by the unit 28 and processed in unit 29. Controller 31 is connected to the fundamental RF generator 14 to allow the magnitude and/or frequency of the fundamental RF voltage to be varied for providing mass selection. The controller 31 is also connected to the supplementary RF generator 35 to allow the magnitude and/or frequency of the supplementary RF voltage to be varied or gated. The controller on line 32 gates the filament lens controller 21 to provide an ionizing electron beam only at time periods other than the scanning interval. Mechanical details of ion traps have been shown, for example, U.S. Pat. No. 2,939,952 and more recently in U.S. patent application Ser. No. 454,351 12/29/82 assigned to the present assignee.

The symmetric fields in the ion trap 10 lead to the well known stability diagram shown in FIG. 2. The parameters a and q in FIG. 2 are defined as

$$a = -8\, eU/mr_0^2\omega^2$$

$$q = 4\, eV/mr_0^2\omega^2$$

where e and m are respectively charge on and mass of charged particle. For any particular ion, the values of a and q must be within the stability envelope if it is to be trapped within the quadrupole fields of the ion trap device.

The type of trajectory a charged particle has in a described three-dimensional quadrupole field depends on how the specific mass of the particle, m/e, and the applied field parameters, U, V, r_0 and ω combined to map onto the stability diagram. If the scanning parameters combine to map inside the stability envelope then the given particle has a stable trajectory in the defined field. A charged particle having a stable trajectory in a three-dimensional quadrupole field is constrained to a periodic orbit about the center of the field. Such particles can be thought of as trapped by the field. If for a particle m/e, U, V, r_0 and ω combine to map outside the stability envelope on the stability diagram, then the given particle has an unstable trajectory in the defined field. Particles having unstable trajectories in a three-dimensional quadrupole field obtain displacements from the center of the field which approach infinity over time. Such particles can be thought of escaping the field and are consequently considered untrappable.

For a three-dimensional quadrupole field defined by U, V, r_0 and ω, the locus of all possible mass-to-charge ratios maps onto the stability diagram as a single straight line running through the origin with a slope equal to -2 U/V. (This locus is also referred to as the scan line.) That portion of the loci of all possible mass-to-charge ratios that maps within the stability region defines the region of mass-to-charge ratios particles may have if they are to be trapped in the applied field. By properly choosing the magnitude of U and V, the range of specific masses to trappable particles can be selected. If the ratio of U to V is chosen so that the locus of possible specific masses maps through an apex of the stability region (line A of FIG. 2) then only particles within a very narrow range of specific masses will have stable trajectories. However, if the ratio of U to V is chosen so that the locus of possible specific masses maps through the middle of the stability region (line B of FIG. 2) then particles of a broad range of specific masses will have stable trajectories.

According to the present invention, the ion trap of the type described above is operated as follows: ions are formed within the trap volume **16** by gating a burst of electrons from the filament **17** into the trap. The DC and RF voltages are applied to the three-dimensional electrode structure such that ions of a desired mass or mass range will be stable while all others will be unstable and expelled from the trap structure. This step may be carried out by using only the RF potential so that the trapped ions will lie on a horizontal line through the origin in the stability diagram of FIG. 2 (a=0). The electron beam is then shut off and the trapping voltages are reduced until U becomes 0 in such a way that the loci of all stably trapped ions will stay inside the stability region in the stability diagram throughout this process. The value of q must be reduced sufficiently low so that not only the ions of interest but any fragment ions which are formed therefrom in a subsequent dissociation process to be described below will also remain trapped (because a lower mass-to-charge ratio means a large q value).

In the dissociation step, the ions of interest are caused to collide with a gas so as to become dissociated into fragments which will remain within the trap, or within the stability region of FIG. 2. Since the ions to be fragmented may or may not have sufficient energy to undergo fragmentation by colliding with a gas, it may be necessary to pump energy into the ions of interest or to cause them to collide with energetic or excited neutral species so that the system will contain enough energy to cause fragmentation of the ions of interest. The fragment ions are then swept from the trap by the RF voltage along the horizontal line a=0 in FIG. 2 so as to be detected.

Any of the known ways of producing energetic neutral species may be used in the preceding step. Excited neutrals of argon or xenon may be introduced from a gun, pulsed at a proper time. A discharge source may be used alternatively. A laser pulse may be used to pump energy into the system, either through the ions or through the neutral species.

In what follows, there will be shown results of experiment for determining in the case of nitrobenzene ions (with molecular weight M=123 and degree of ionization Z=1) what fragment ions (daughter ions), what fragment ions of fragment ions (granddaughter ions), etc. will arise when dissociation of the parent ions is induced by collisions with a background gas such as argon and the resultant ions out of the ion trap are scanned to determine their mass spectrum.

FIG. 3(A) is an electron ionization mass spectrogram of nitrobenzene. Line M/Z=124 arises from an ion-molecule reaction which adds a proton to M/Z=123.

Operating in the mode with U=0 and with 1×10^4 torr of Ar; the RF voltage was adjusted first such that only ions with M/Z greater than 120 would be stored in the ion trap at the end of sample ionization. The RF voltage was then lowered such that the cut-off value would be M/Z=20 so that ions with M/Z above this value would be trapped or stable in the ion trap. Parent ions with M/Z=123 which remained trapped in the ion trap after ionization collided with a background gas of argon and dissociated. Next the RF was scanned up and the mass spectrogram shown in FIG. 3(B) was obtained, representing the ions produced from the parent with M/Z=123.

A variety of new scan modes becomes possible with the superposition of an AC field such as an RF field. For any ion stored in the ion trap, the displacement in any space coordinate must be a composite of periodic function of time. If a supplementary RF potential is applied that matches any of the component frequencies of the motion for a particular ion species, that ion will begin to oscillate along the coordinate with increased amplitude. The ion may be ejected from the trap, strike an electrode, or in the presence of significant pressure of sample or inert damping gas may assume a stable trajectory within the trap of mean displacement greater than before the application of the supplementary RF potential. If the supplementary RF potential is applied for a limited time, the ion may assume a stable orbit, even under conditions of low pressure.

FIG. 4 illustrates a program that may be used for a notch-filter mode. Reference being made to this figure, ions of the mass range of interest are produced and stored in period A, and then the fundamental RF voltage applied to the ring electrode is increased to eject all ions of M/Z less than a given value. The fundamental RF voltage is then maintained at a fixed level which will trap all ions of M/Z greater than another given value (period D). A supplementary RF voltage of ap-

propriate frequency and magnitude is then applied between the end caps and all ions of a particular M/Z value are ejected from the trap. The supplementary voltage is then turned off and the fundamental RF voltage is scanned to obtain a mass spectrum of the ions that are still in the trap (period E).

FIG. 5(A) shows a spectrum of xenon in which the fundamental RF voltage is scanned as in FIG. 4 but in which a supplementary voltage is not used. FIG. 5(B) shows a spectrum obtained under similar conditions but a supplementary voltage of appropriate frequency and magnitude is used to eject ions of M/Z=131 during period D. FIG. 5(B) shows that these ions are largely removed from the trap. There are many ways of actually using the notch-filter mode. For example, the supplementary RF voltage might be turned on during the ionization period and turned off at all other times. An ion which is present in a large amount would be ejected to facilitate the study of ions which are present in lesser amounts.

Other useful scan modes are possible by using the supplementary field during periods in which the fundamental RF voltage or its associated DC component is scanned rather than maintained at a constant level. For example, if a supplementary voltage of sufficient amplitude and fixed frequency is turned on during period E (instead of during period D), ions will be successively ejected from the trap as the fundamental RF voltage successively produces a resonant frequency in each ion species which matches the frequency of the supplementary voltage. In this way, a mass spectrum over a specified range of M/Z values can be obtained with a reduced maximum magnitude of the fundamental RF voltage or a larger maximum M/Z value may be attained for a given maximum magnitude of the fundamental RF voltage. Since the maximum attainable value of the fundamental RF voltage limits the mass range in the ordinary scan mode, the supplementary RF voltage extends the mass range of the instrument.

Useful scan modes are also possible in which the frequency of the supplementary voltage is scanned. For example, the frequency of the supplementary voltage may be scanned while the fundamental RF voltage is fixed. This would correspond to FIG. 4 with period E absent and the frequency of the supplementary RF voltage being scanned during period D. A mass spectrum is obtained as ions are successively brought into resonance. Increased mass resolution is possible in this mode of operation. Also, an extended mass range is attainable because the fundamental RF voltage is fixed.

The presence of a supplementary RF voltage may induce fragmentation of ions at or near resonance. FIG. 6(A) shows a spectrum of nitrobenzene (with 1×10^{-3} torr He) acquired with the scan program of FIG. 4 but without a supplementary RF voltage. All ions of M/Z less than 118 are ejected before and during period B so that the small peak at M/Z=93 must have been formed after period B and before the ejection of ions of M/Z=93 during period E FIG. 6(B) shows a spectrum obtained under the same conditions except that a supplementary RF voltage at the resonant frequency of M/Z=123 was applied during interval D. The spectrum shows abundant fragment ions at M/Z=93 and 65. Similarly, FIG. 6(C) was acquired as was FIG. 6(A), except that all ions of M/Z less than 88 are ejected before and during period B. FIG. 6(D) was acquired under the same conditions as FIG. 6(C), except that a supplementary RF voltage at the resonant frequency of M/Z=93 was applied during interval D. This spectrum shows an abundant fragment at M/Z=65.

Sequential experiments are possible in which daughter ions are produced with the supplementary RF field and granddaughter ions are then produced from those daughter ions by adjusting the conditions such as voltage or frequency of the fundamental RF field or the supplementary RF field so that the daughter ions are brought into resonance. FIG. 7 shows a particular way in which daughter ions may be produced. The frequency of the supplementary RF voltage remains constant but the fundamental RF voltage is adjusted during period DA to bring a particular parent ion into resonance so that granddaughter ions are produced. During period DB, the fundamental RF voltage is adjusted to bring a particular daughter ion into resonance so that granddaughter ions will be produced. FIG. 8(A) shows a spectrum of n-heptane during the acquisition of which the scan program of FIG. 7 was used, except that no supplementary RF voltage was used. Since all ions of M/Z less than 95 were ejected before and during period B, the small peaks at M/Z=70 and 71 must be due to ions that were formed after period B. FIG. 8(B) was obtained by using the scan program shown in FIG. 4 with a supplementary frequency at the resonant frequency of M/Z=100. Abundant daughter ions at M/Z=70 and 71 are seen, and less intense peaks at M/Z=55, 56 and 57 are evident. FIG. 8(C) was acquired with the scan program used for FIG. 8(A), except that a supplementary RF voltage was used. The fundamental RF voltage during periods DA and DB, and the frequency of the supplementary RF voltage were chosen so that M/Z=100 was in resonance during period DA so that daughter ions were produced. A particular daughter was M/Z=70 that was produced during period DA was brought into resonance during period DB so that granddaughter ions were produced. These granddaughter ions are evident in FIG. 8(C) as the increased intensities of the peaks at M/Z=55, 56 and 57. FIG. 8(D) is similar to FIG. 8(A) except that M/Z=100 was in resonance during DA, and M/Z=71 was in resonance during DB.

Many other schemes may be used to obtain sequential daughter scans. For example, the frequency of the supplemental RF field may be changed instead of changing the fundamental RF voltage. Also, the trap may be cleared of undesired ions after daughter ions have been produced but before granddaughter ions are produced. Of course, further fragmentation may be induced by sequentially changing the fundamental RF voltage or the frequency of the supplementary RF voltage to bring the products of successive fragmentations into resonance.

The present invention has been disclosed above in terms of only a limited number of examples but various modifications which may be made thereon are still considered within the purview of the present invention. For example, the applied RF voltage need not be sinusoidal but is required only to be periodic. A different stability diagram will result but its general characteristics are similar, including a scan line. In other words, the RF voltage could comprise square waves, triangular waves, etc. The quadrupole ion trap would nevertheless operate in substantially the same manner. The ion trap sides were described above as hyperbolic but the ion traps can be formed with cylindrical or circular trap sides. Any electrode structure that produces an approximate three-dimensional quadrupole field could be used. The

scope of the invention is limited only by the following claims.

What is claimed is:

1. A method of mass analyzing a sample comprising the steps of

defining a trap volume with a three-dimensional quadrupole field adapted to trap ions within a predetermined range of mass-to-charge ratio,

forming or injecting ions within said trap volume such that those within said predetermined mass-to-charge range are trapped within said trap volume,

changing said quadrupole field to eliminate ions having a mass-to-charge ratio other than that of the ions of desired charge-to-mass ratio to be analyzed,

readjusting said quadrupole field to capture daughter ions of said ions of desired charge-to-mass ratio

dissociating or reacting said trapped desired ions such that those of said ions and said daughters within a desired range of mass-to-charge ratio remain trapped within said trap volume, and

then charging the quadrupole field to cause ions of consecutive mass to escape said trap volume for detection.

2. The method of claim 1 wherein said quadrupole field is generated by an ion trap having a ring electrode and spaced end electrodes, said quadrupole field being defined by U=amplitude of a direct current voltage between said end electrodes and said ring electrode, V=magnitude of an RF voltage applied between said ring electrodes, and $\omega=2\pi\times$frequency of said RF voltage.

3. The method of claim 2 wherein said step of controlling said quadrupole field is effected by changing one or more of U, V and ω.

4. The method of claim 3 wherein U is changed to 0.

5. The method of claim 1 wherein said step of forming ions is effected by gating a burst of electrons into said trap volume.

6. The method of claim 2 wherein said step of forming ions is effected with U=0.

7. The method of claim 1 further comprising the step of pumping energy into said trapped ions.

8. The method of claim 1 further comprising the step of causing said trapped ions to collide with energetic background particles.

9. The method of claim 1 wherein said step of controlling said quadrupole field and dissociating said trapped ions includes the step of superposing a supplementary AC field.

10. The method of claim 9 wherein said supplementary field is turned on while the intensity of said quadrupole field is fixed.

11. The method of claim 9 wherein said quadrupole field and supplementary field are controlled such that during a first period one of said trapped ions is in resonance and that during a subsequent second period one of fragments of said one ion is in resonance.

12. A method of scanning ions within a predetermined range of mass-to-charge ratio trapped within a trap volume with a three-dimensional quadrupole trapping field, comprising the steps of applying a supplementary AC field superposing and trapping field to *provide a combined trapping field and changing the combined trapping field to successively* eject out of said trap volume those of said ions with particular mass-to-charge ratios, *and* detecting said ions[, and thereafter changing the intensity of said trapping field].

13. The method of claim 12 wherein *the frequency of* said supplementary field is [turned on] *scanned* while the intensity of said trapping field is fixed.

14. The method of claim 12 wherein said supplementary field is turned on while the intensity of said trapping field is [varied] *scanned*.

15. A method of mass analyzing a sample comprising the steps of

defining a trap volume with a three-dimensional quadrupole field adapted to trap ions within a predetermined range of mass-to-charge ratio,

forming or injecting ions within said trap volume such that those within said predetermined mass-to-charge range are trapped within said trap volume,

applying a supplementary AC field superposing said three-dimensional quadrupole field to form combined fields, and

scanning said combined fields to cause ions to consecutive mass-to-charge ratio to escape said trap volume for detection.

16. The method of claim 15 wherein the frequency of said supplementary field is scanned while the intensity of said trapping field is fixed.

17. The method of claim 15 wherein said supplementary field is turned on while the intensity of said trapping field is scanned.

18. The method of claim 17 wherein the frequency of said supplementary field is constant

19. A method of mass analyzing a sample comprising the steps of

defining a trap volume with a three-dimensional quadrupole field adapted to trap ions within a predetermined range of mass-to-charge ratio, wherein said quadrupole field is generated by an ion trap having a ring electrode and spaced end electrodes, said quadrupole field being defined by U=amplitude of a direct current voltage between said end electrodes and said ring electrode, V=magnitude of an RF voltage applied to said electrodes, and $\omega=2\pi\times$frequency of said RF voltage,

forming or injecting ions within said trap volume such that those within said predetermined mass-to-charge range are trapped within said trap volume,

applying a supplementary AC field superposing said three-dimensional quadrupole field to form combined fields, wherein said supplementary field is defined by V2=magnitude of an RF voltage applied between said end cap electrodes, and $\omega_2=2\pi\times$frequency of said AC field, and

controlling the combined fields by changing one or more of U, V, ω and ω_2 to cause said ions of consecutive mass to escape said trap volume for detection.

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